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Identifying Best Bet Entry-Level Selection Measures for US Air Force Remotely Piloted Aircraft (RPA) Pilot and Sensor Operator (SO) Occupations

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Sponsored by

HQ AFPC/DSYX & HQ AF/A1PF

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14. ABSTRACT *(Maximum 200 words)*:
In this project, we selected "best bet" predictor measures to help the U.S. Air Force (USAF) identify early career officers and airmen likely to succeed as a Remotely-Piloted Aircraft (RPA) Pilot (officer) or Sensor Operator (enlisted). We compiled existing information about skills, abilities, and other characteristics (SAOCs) predictive of success in RPA Pilot or SO training and information about the context in which this work is performed. We organized the SAOCs from diverse sources according to the U.S. Department of Labor's O*NET content model to minimize redundancy across constructs and to ensure broad coverage of several different domains of individual differences. Ultimately, 21 critical SAOCs were identified, most of which can be adequately measured with assessments already used by or accessible to the USAF. After considering practical constraints on the entry-level selection process for officers and airmen, we recommended two possible *batteries* of predictor measures for each position (Pilot and Sensor Operator). Finally, we addressed measurement gaps by developing a measure of time-sharing ability that does not couple cognitive processing and psychomotor tasks and a Person-Environment (P-E) fit measure customized for the RPA work context. The new measures require further evaluation before they can be used to make operational decisions.

15. SUBJECT TERMS
Remotely-Piloted Aircraft; Unmanned Aerial System; personnel selection, psychological tests; pilot selection; sensor operator selection; enlisted selection

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Executive Summary

The purpose of this research effort was to select "best bet" predictor measures that could be used to identify entry-level or early career officers and airmen for Remotely-Piloted Aircraft (RPA) pilot (officer) or sensor operator (SO; enlisted) positions. When this project began in September 2009, a great deal of work had already been conducted on RPA operator job requirements and training. There were also several ongoing initiatives focusing on RPA pilot and sensor operator (SO) selection, including efforts conducted by the 711 HPW/HP and USAF School of Aerospace Medicine (USAFSAM/FEC), both at Brooks City Base, TX, and efforts at 711 HPW/RHAS at Mesa, AZ. The Air Force Personnel Center, Research and Analysis Branch contracted with the Human Resources Research Organization (HumRRO) to review and qualitatively analyze information available from these earlier and ongoing efforts, and to map this information against existing taxonomies of SAOCs to determine if there are any gaps in coverage. We compiled information about the skills, abilities, and other characteristics (SAOCs) required in the RPA pilot and SO jobs and used the U.S. Department of Labor's O*NET content model as an organizing structure to ensure that we covered all of the important domains (e.g., abilities, skills, work style preferences, work context) and to provide a well-researched taxonomic structure and labels for the disparate sources of information. RPA subject matter experts (SMEs) and the Air Force Personnel Center (AFPC) project team helped narrow the list to those SAOCs most critical to measure in an entry- level selection process. Next, we worked with the AFPC team to take account of practical considerations in the entry-level selection process, such as constraints on testing time and requirements for large-scale testing. Ultimately, we identified a "best bet" predictor and at least one alternate predictor for as many of the critical SAOCs as possible, and then created two options for a recommended entry-level selection battery for each position (Pilot and SO). One option makes maximal use of existing operational selection tools and administration processes; the second replaces some of the existing selection tools with others that have demonstrated evidence of reliability and validity, as well as at least some evidence that they result in smaller gender subgroup score differences (and possibly smaller race/ethnic subgroup score differences).

We also developed two new predictor measures to address measurement gaps. The first is a measure of time sharing ability that involves performing multiple tasks simultaneously, but does not pair cognitive processing tasks with psychomotor tasks. This measure can be administered on the existing Test of Basic Aviation Skills (TBAS) platform and has a modular programming foundation that provides a great deal of flexibility for future research and adaptations. The second measure is an RPA-specific Person-Environment (P-E) fit inventory. This instrument is best suited for use as a self-assessment tool that can help potential recruits determine if the RPA work context would be a good fit for their work preferences. It could provide an opening for recruiters to discuss the RPA career field with candidates prior to accessioning.

In the future, the USAF can consider developing measures to address other measurement gaps identified in this project including judgment and decision making, critical thinking, teamwork skills, and/or oral expression and comprehension skills. Prior to developing such measures, we recommend further exploration of the likely increment in prediction beyond that provided by existing measures, relative to the cost of increased testing time or adding a requirement for non-standard equipment (e.g., the capability to capture audio input).

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Introduction

The demand for RPA support has grown dramatically over the last several years (Schanz, 2010), to the point where the training pipeline for RPA pilots and sensor operators (SOs) cannot meet the demand (*UAS Operator Way Ahead,* 2008; U.S. GAO, 2010). The Air National Guard (ANG) has played a key role in meeting this demand, operating RPA squadrons in Arizona, California, North Dakota, and Texas (Schanz, 2010). In addition, the Active Duty Air Force has pursued several strategies for increasing the number of RPA pilots and SOs (Church, 2011; Tirpak, 2010). The first strategy was to cross-train rated personnel to fly RPAs. Obviously, these individuals already had extensive training and experience as a pilot. The Active Duty Air Force also began funneling some Specialized Undergraduate Pilot Training (SUPT) graduates into RPA training, rather than into other air frames. Both of these strategies have the disadvantage of reducing the number of rated personnel available for other air frames. In 2009, the Air Education and Training Command (AETC) beta tested a program designed to train non-pilots to fly RPAs. These officers included rated navigators and officers from non-flying career fields. In October 2009, the Air Force created a dedicated RPA career field, 18X, as a rated Air Force specialty code (AFSC), and developed Undergraduate RPA Training (URT) for RPA pilots, with the first class beginning in the fall of 2010 (Lyle, 2010). The U.S. Air Force Academy (USAFA) also provides three introductory courses related to RPA flight and management, with the goal of feeding graduates directly into URT (Hoffman, 2010).

In addition to the shortage of RPA Pilots, there is also an unmet demand for RPA SOs (Hoffman, 2009). The SO job is filled by enlisted personnel. Originally, Active Duty RPA SOs were drawn from airmen with a background in imagery analysis (IA). In contrast, in the ANG, SOs were drawn from a wide variety of technical backgrounds. In January 2009, the Air Force established a new, dedicated AFSC, 1U0X1, Unmanned Aerospace System (UAS) Sensor Operator, and developed an SO-specific training course later that year. The first SO training course to include enlisted personnel directly from basic military training (BMT) occurred in January 2010 (Bowlin, 2010).

Objectives

The purpose of this research effort was to select "best bet" predictor measures that could help the U.S. Air Force (USAF) identify entry-level or early career officers and airmen likely to succeed in RPA positions. The first step in this process involved specifying the job requirements of RPA pilots and SOs, specifically, the skills, abilities, and other characteristics (SAOCs) predictive of success in RPA pilot or SO training and the propensity to make RPAs a career. The SAOC requirements, in turn, provide the basis for selection requirements and predictor measures that can be used in the entry-level selection process. The USAF has extensive experience in the development and validation of selection methods for other aircrew occupations (pilots, combat system operators, air battle managers) (Carretta, 2008; Carretta & Ree, 2003; Olea & Ree, 1994). This body of knowledge provides a firm foundation for delineating selection methods and tools for the new RPA career fields.

When we began this project in September 2009, a great deal of work had already been conducted to identify RPA job requirements and more was underway (e.g., Tvaryanas, 2006; *UAS Operator Way Ahead,* 2008). Front-end analyses were available for Predator pilots (Kalita & Duma, 2008a; Nagy, Kalita, & Eaton, 2006a) and Predator SOs (Kalita & Duma, 2008b; Nagy, Eaton, & Muse, 2006b). However, these analyses were based on small samples and did not identify detailed SAOC requirements. There were also several ongoing initiatives focusing on RPA selection, including efforts conducted by the 711 HPW/HP and USAF School of Aerospace Medicine (USAFSAM/FEC), both at Brooks City Base, TX, and efforts at 711 HPW/RHAS at Mesa, AZ. For example, 711 HPW/RHA had recently completed Mission Essential Competency (MEC) analyses for the Predator and Reaper RPAs. The MECs for these two RPAs detail competencies exhibited by successful personnel in an operational environment, including, an Initial Competency Set (ICS) that is the foundation for learning to operate Predator and Reaper RPAs. (Additional training and development would be required to master all operational MECs.)

USAFSAM/FEC also had conducted several relevant activities. First, it developed a profile for successful RPA pilots and SOs based on interviews and focus groups conducted with RPA personnel (e.g., Wing CCs, Squadron CCs and DOs, Pilots, and SOs) (personal communication, Dr. Wayne Chappelle, October 30, 2009). This profile initially comprised 125 attributes grouped into 12 broader domains. The initial set of attributes was then distilled into 16 critical attributes covering 4 domains (both cognitive and noncognitive). USAFSAM/FEC had also met with United Kingdom (UK) Royal Air Force (RAF) scientists concerning the RAF's job analysis of their RPA pilot and SO positions. The UK RAF was in the process of developing and validating a RPA selection battery (Bailey, 2008).

*

The Air Force Personnel Center, Research and Analysis Branch (hereafter AFPC), required technical assistance to review and qualitatively analyze information available from these earlier and ongoing efforts, and to map this information against existing taxonomies of SAOCs to determine if there are any gaps in coverage. If any gaps were identified, AFPC requested technical assistance in identifying potential measures of the missing SAOCs or, possibly, efforts to develop such measures. The overall goal of these analyses was to help AFPC identify a reasonable number of "best bet" measures for assessing critical entry-level SAOCs for RPA pilot and SO positions in the Active Duty USAF.

The UK RAF Predator selection battery was of particular appeal in this effort because it was developed specifically for the population of interest. Unfortunately, it became apparent within a few months of contract award that we would not be able to do a focused study of the test battery because (a) some portions were still under development and (b) the UK RAF was not yet ready to engage in a collaborative study with AFPC. Consequently, the AFPC project team directed HumRRO to explore other potential predictor measures, including those already being used for selection into RPA pilot/SO training or similar jobs and those targeting SAOCs that job analytic work suggested were important for the RPA pilot and/or SO job.

Approach

The AFPC project team provided access to several technical reports and briefing slides that touched on RPA pilot and SO job duties in the USAF and the SAOCs required to perform

those duties. HumRRO supplemented these source documents through key word searches in information repositories such as the Defense Technical Information Center (DTIC) and through our own contacts in the U.S. Army and the USAF. Primary sources included:

- MECs for Predator, Reaper, and Global Hawk RPA platforms/missions provided by the Air Force Research Laboratory, Warfighter Readiness Research Division (711 HPW/RHAS)[1]

- In-progress information about job analytic research being conducted by USAFSAM (personal communication, Dr. Wayne Chappelle, October 30, 2009; Chappelle, McDonald, & King, 2010[2]; Chapelle, McDonald, & McMillan, 2011)

- Front End analysis of Predator pilot and SO job requirements (Kalita & Duma, 2008a; 2008b; Nagy, Eaton, & Muse, 2006b; Nagy, Kalita, & Eaton, 2006a)

- AF Briefing Slides (4 August 2008). *UAS Operator Way Ahead* provided by the AFPC project team.

- Tvaryanas (6 August 2006). *Unmanned aircraft systems (UAS) skill sets.* Briefing slides provided by the AFPC project team.

Description of RPA Work Context and Job Activities Provided in Source Documents and by USAF Subject Matter Experts (SMEs)

Figure 1 shows two images of ground control stations (GCS) used by RPA pilots and SOs. The configuration of the GCS can and does vary from one unit to another, and these images are likely already at least somewhat outdated. Still, the images illustrate what subject matter experts (SMEs) and the sources above conveyed: all GCS involve multiple sources of visual information displayed on several two-dimensional high-resolution monitors. Visual information comes in the form of terrain maps and satellite images, text, numerical information, and dashboard analogs of the gauges or dials that might appear in the cockpit of a manned aircraft. All GCS configurations also include multiple modes of communication, including information presented through a headset, e-mail and chat capabilities, and a landline telephone. Within these modes of communication, there can be multiple streams of information, for example, several different chat rooms, oral communication with several different parties over the headset, and more than one line on the landline telephone. SMEs informed us that multi-tasking is occurring most of the time, in the sense that there is more than one channel of information to be attended to and processed. There is variability in the number of sources and amount of information coming in at once, the rate at which things are happening, and the level of consequences associated with multi-tasking performance. At the lowest intensity levels, RPA pilots and SOs can easily shift attention from one display to another at a relatively slow pace and with little negative impact if they fail to notice something. At the highest intensity levels, the information overload becomes very difficult to handle, but the stakes are very high

[1] The MECs are not available for general public distribution so are not listed in this report.
[2] In 2009, Dr. Wayne Chappelle provided information about SAOC requirements from ongoing research. We did not have access to the 2010 or 2011 reports cited here when we were identifying SAOC requirements

(e.g., failure to protect friendly forces or loss of the aircraft). During times of information overload, it is critical for RPA pilots and SOs to realize that they are becoming task saturated and to *tell* others so they can help. The images in Figure 1 helped us understand the perceptual and cognitive load placed on RPA pilots and SOs.

Figure 1. Images of the ground control station (GCS).

Following is a summary of how a "typical" shift might play out for an RPA crew, as described by several experienced RPA pilots and SOs. At the beginning of the shift, the RPA pilot and SO nest in to their workstation, often taking over from a crew that has been flying the RPA for the preceding work shift. After nesting in, there is often a period of minutes or hours of relatively little activity as the RPA flies to its final destination, or as it circles an area where it is providing surveillance and not much is happening. During this time, the crew must monitor the (a) status of the RPA, (b) chat room messages, (c) radio transmissions that might be relevant for them, (d) changes in the airspace, and (e) other aircraft operating in the same or nearby airspace. During these periods, maintaining vigilance is a bigger challenge than worrying about information overload. This can be especially hard when the crew is working a night shift or is fatigued. The crew can use the slow time to do lower priority tasks such as completing flight logs or other administrative paperwork. Often the RPA must pass through or around airports and/or Restricted Operating Zones (ROZ) on its way to the target destination, so the RPA crew must coordinate the airspace as they go. As soon as the RPA arrives in the target airspace, the crew usually encounters other air traffic in that space so airspace coordination must continue.

A fairly common occurrence that involves a moderate degree of intensity is flying along "fat, dumb, and happy" in a particular airspace and then being notified that the RPA can no longer be in that airspace. At this point, there likely will be other aircraft stacked in the area–as close as every 500 feet vertically. When this happens, the pilot must contact Air Traffic Control (ATC) to request a move to a new airspace. This can take 20 minutes of searching and communicating. Another fairly common occurrence is that the mission rapidly changes from quiet and boring to very intense. Here, the most common example is when friendly forces come under fire (or encounter a roadside bomb). Suddenly, the RPA crew experiences a "fire hose" of information. There is typically a Joint Terminal Attack Controller (JTAC) on the ground calling for assistance who may be quite emotional. Several other people in the area typically also start communicating on the radio and/or by chat, for example, other nearby ground forces, other aircraft in the area, and military commanders who are in the chain of command of the unit under fire. At this intense time, the SO often must concentrate on keeping the camera on an identified target, while also maintaining enough situational awareness to help the pilot keep the RPA in the right position and be alert for potential problems (e.g., coming too close to other aircraft in the area). The target could be fixed or moving. Ideally, the SO will be thinking ahead to how the aircraft will need to be positioned in order to maintain a good camera angle on the target, and conveying this information to the pilot. The camera cannot take a picture of something that is directly below the aircraft. Therefore, if the pilot does not keep the aircraft in a good position, the SO may lose visual contact. The SO cannot prevent this from happening, except to help the pilot avoid flying directly over the target. While the SO is focusing on keeping the camera on the target, the Pilot attempts to keep the aircraft in the best position to maintain visual contact with the target and tries to "stay ahead of the aircraft" so they can anticipate where the aircraft should best be positioned in the future. At the same time, the pilot needs to maintain an awareness of other aircraft in the area, and other ground forces or combatants that may start firing their weapons. The pilot needs to get permission from ATC to open up a ROZ, and these requirements may change during the mission, especially when tracking a moving object. The pilot does this by calling ATC. The pilot also is monitoring communications from several sources, including the JTAC, the pilot's own RPA Mission Commander (MC), other units in the area, and so on. Both the pilot and SO can delegate some tasks to the MC (e.g., monitoring

chat from some of the sources or setting up and gaining access to a ROZ). Pilots vary in how much they are willing to delegate responsibility, depending on their assessment of how much they trust the SO or MC to handle the delegated tasks. To make this kind of situation even more intense, there could be a problem with the satellite link or with the RPA itself. When this happens, maintenance crews will be in the GCS working on the equipment. Finally, the pilot may need to notice and respond to an aircraft status indicator while trying to do all of the above.

Other Sources of Information about SAOC Requirements

In addition to compiling the preceding word picture of the RPA work context and work activities, HumRRO expanded the search to include as much information as we could find about duty and SAOC requirements for similar jobs, including the following:

- RPA pilots other than those in the USAF, including the UK RAF, U.S. Army, and NASA. Some of these documents included formal studies of job requirements; many were popular press articles describing job duties and SAOC requirements with varying degrees of detail and rigor (Bailey, 2008; Barnes, Knapp, Tillman, Walters & Velicki, 2000; Biggerstaff, Blower, Portman, & Chapman, 1998; Bruskiewicz, Houston, Hezlett, & Ferstl, 2007; Kay, Dolgin, Wasel, Langelier & Hoffman, 1999; Montijo, Kaiser, Spiker, & Nullmeyer, 2008; Pestana, 2007).
- Pilots of military manned aircraft, including both fixed and rotary wing (Agee, Shore, Alley, Barto, & Halper 2009; Bruskiewicz, Katz, Houston, Paullin, O'Shea, & Damos 2007; Driskill, Koonce, Nance, & Weissmuller 2001; Kubisiak & Katz, 2006; Mangos, Arnold, Mead, Merket, Littrell, Credo, Young, Tolentino, & Kessler, 2005; Paullin, Katz, Bruskiewicz, Houston, & Damos, 2006).

Given that our charge was to identify *entry-level selection requirements*, we focused most of our efforts on identifying SAOC requirements, and less on delineating specific job tasks. In fact, the MECs capture all critical duties at a sufficient level of detail to infer SAOC requirements, as judged by RPA SMEs. The UK RAF Predator study (Bailey, 2008) also identified a set of duty requirements very similar to the MECs. Furthermore, both the MEC and UK RAF studies concluded that there is little difference in duty requirements across the MQ-1 (Predator) and MQ-9 (Reaper) aircraft that are most typically flown by USAF personnel, and relatively little difference in duty requirements between the RPA pilot and the SO.

Each group of researchers used its own labels and its own organizing structure for the SAOCs, so one of our challenges was finding a way to integrate all of the existing information into a meaningful organizational framework. We wanted a framework that would lead to differentiable and measurable individual differences constructs, and one that is widely used, so we turned to the U.S. Department of Labor's Occupational Information Network (O*NET). Mangos et al. (2005) followed a similar procedure when analyzing job requirements for Navy aviators.

O*NET is a comprehensive system developed for the U.S. Department of Labor that provides information for more than one thousand occupations within the U.S. economy. This

information is maintained in a comprehensive database which was developed to replace the Dictionary of Occupational Titles (DOT) (U.S. Department of Labor, 1991). This taxonomy is organized hierarchically and is based on decades of taxonomic research in the arenas of abilities, skills, personality traits (which are called Work Styles in the O*NET framework), and work context factors. The O*NET Content Model was developed based on a thorough review of an extensive body of literature from the job analysis arena within the field of industrial-organizational psychology (McCloy, Campbell, Oswald, Lewis, & Rivkin, 1999; Peterson, 1999). The O*NET Content Model contains four types of descriptors: job-oriented, worker-oriented, cross-occupational, and occupation-specific. In turn, these descriptors are organized into the six domains shown in Figure 2. For purposes of this project, we focused on Worker Characteristics that would be present at entry to an RPA career field, in keeping with our charge to focus on entry-level requirements. We also examined one aspect of the Occupational Requirements domain–Work Context– because the RPA work environment involves several salient and fairly unique context factors, including flying battle missions from a remote location and experiencing much of the emotional stress that accompanies manned flight without the physical and physiological characteristics of manned flight.

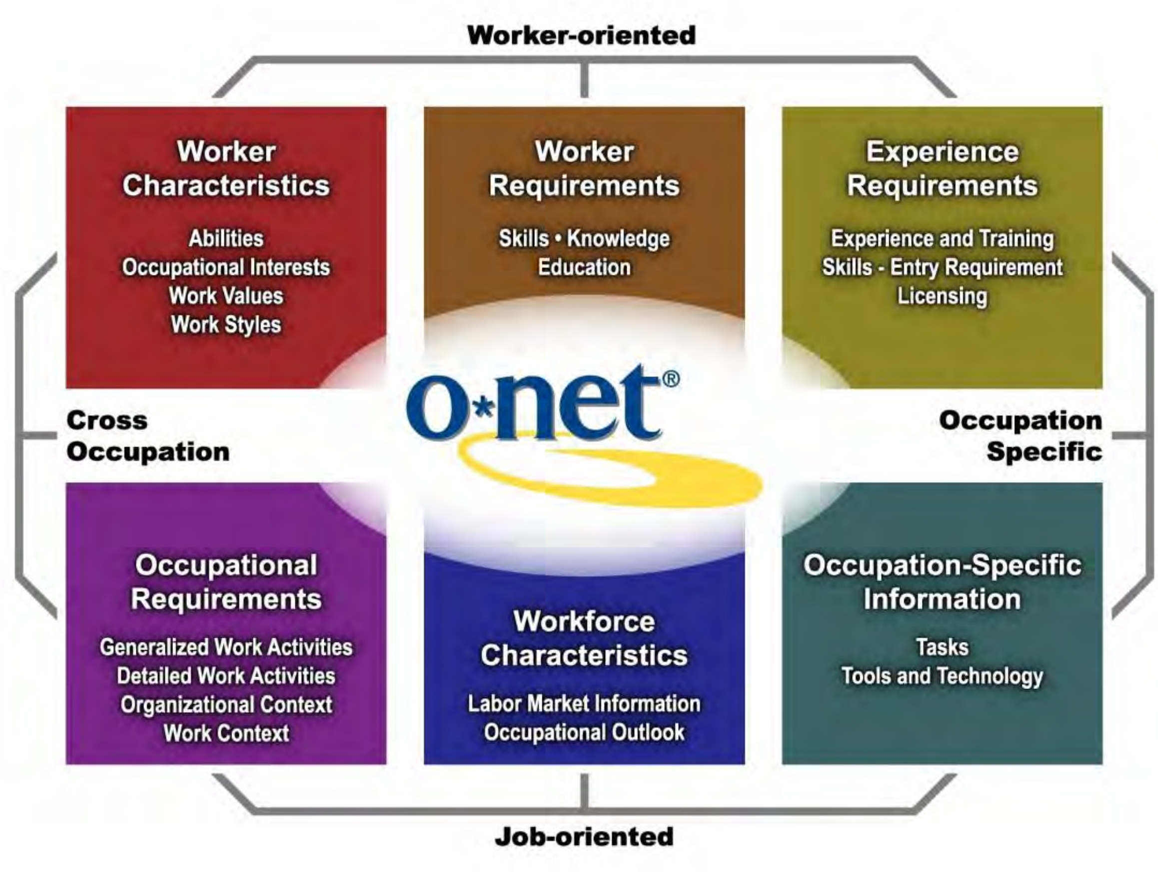

*Figure 2. O*NET content model.*

Compiling an SAOC List

We initially compiled a comprehensive list of 10 Skills, 25 Abilities, and 12 Work Styles. The list can be found in Appendix A. The HumRRO team applied its extensive knowledge of individual differences taxonomies, and the O*NET taxonomy in particular, to map SAOCs listed in various reports onto the O*NET Content Model. Each of the selected SAOCs was mentioned as important for performing the RPA pilot and/or SO job, or a similar job (i.e., manned aircraft pilot) in one or more of the sources cited above. The one concept that did not appear in the O*NET content model but was included in our initial list was "situational awareness." This skill is commonly cited by aviators as a critical skill, so it was included in the list at this point.

Next, we asked several people knowledgeable about the USAF RPA pilot and SO jobs to review the list. The SMEs are shown in Table 1. As a group, they had experience in screening for manned and RPA pilot training, developing and delivering training for RPA pilots and SOs, establishing the RPA SO career field, and developing RPA training simulators. Several SMEs also had experience flying RPAs. During each meeting, we asked the SMEs to comment on the SAOC list in general and to identify the SAOCs that differentiated unmanned from manned flight or that differentiated RPA pilots from SOs. After the SMEs had reviewed and discussed the entire list, we also asked them if any critical SAOCs were missing. In those cases where SMEs identified missing SAOCs, we were typically able to address their suggestion by slightly modifying the definition for an existing SAOC rather than adding entirely new ones to the list.

Table 2 contains the initial set of 29 SAOCs judged to be important for performing the RPA pilot and SO jobs. It is worth noting that none of the SMEs felt there were any significant differences between the pilot and SO jobs in terms of fundamental SAOC requirements. Next, we narrowed the set to 21 SAOCs based on SME judgments regarding which are the *most critical,* and these are shown in Table 3. We also took into account the trainability of the SAOCs because SAOCs that can be easily trained represent less critical targets for selection purposes. These were consensus judgments based on independent, qualitative input from several iterations of review by USAF SMEs and our own project staff.

Table 1. Subject Matter Experts (SMEs) Who Reviewed RPA SAOC Lists

Name	**Affiliation/Unit**	**Type of Expertise**
Ray King, LtCol	USAF AFMC USAFSAM/FEC	RPA Pilot screening & selection
Wayne Chappelle, Ph.D., Civ	USAF AFMC USAFSAM/FEC	RPA Pilot screening & selection
Victor Allen, CMSgt	USAF AF/A30-AT	RPA SO career field management
Baylen Johnson, SMSgt	USAF AF/A30-AT	RPA SO career field management
Michael Elson, SMSgt	USAF AF/A30-AT	RPA SO career field management
Cami Anderson, MSgt	USAF AF/A30-AT	RPA SO career field management
John Gillis, Civ	USAF AETC/A3F	RPA Pilot training
Jeffrey Wiseman, Civ	USAF AETC/A3FR	Chief, AETC RPA Training Branch
Russell Garner, LtCol	USAF AETC 12 OG/DET 1/DO	RPA operator training
Mark Hand, Maj	USAF AETC 558 FTS/RFC	RPA operator training
Thomas McCurley, LtCol	USAF ACC 16 TRS/DO	RPA operator training
Robert Englehart, Civ	USAF AETC/A3FR	Deputy Branch Chief, HQ AETC RPA Training
Pablo Sanchez, CTR	USAF AFMC 711 HPW/RHA	Pilot Training
Daniel Walker, Col	USAF AFMC 711 HPW/RHA	RPA Pilot Training and operations
Thomas Carretta, Ph.D.	USAF AFMC 711 HPW/RHCI	Expert on USAF Selection
Diane Damos, Ph.D.	Damos Aviation Services	Aviation Psychologist who consults on pilot selection and training for military and civilian clients
William Howse, Ph.D.	Damos Aviation Services	Formerly Chief of the Rotary Wing Aircraft Research Unit, U.S. Army Research Institute for the Behavioral and Social Sciences; currently with Damos Aviation Services

Table 2. List of RPA Pilot and SO SAOC requirements after SME review

Type	Construct	O*NET Definition
Work Style	Initiative	Willingness to take on responsibilities and challenges.
Work Style	Leadership (Assertiveness)	Willingness to speak up and offer suggestions, recommendations, or opinions, even if others may not respond favorably.
Work Style	Cooperation	Being pleasant with others on the job and displaying a good-natured, cooperative attitude.
Work Style	Self Control	Maintaining composure, keeping emotions in check, even in very difficult situations; quickly refocusing attention on task after making an error or witnessing an emotionally disturbing event.
Work Style	Stress Tolerance	Accepting criticism and dealing calmly and effectively with high stress situations.
Work Style	Adaptability/Flexibility	Being open to change (positive or negative) and to considerable variety in the workplace.
Ability	Oral Comprehension	The ability to understand information presented orally in a variety of conditions, including situations in which multiple parties are communicating or under conditions of stress.
Ability	Written Comprehension	The ability to read and understand information and ideas presented in writing.
Ability	Oral Expression	The ability to communicate information and ideas in speaking so others will understand; the ability to use standard codes to convey information orally.
Ability	Deductive Reasoning	The ability to apply general rules to specific problems to produce answers that make sense.
Ability	Inductive Reasoning	The ability to combine pieces of information to form general rules or conclusions (includes finding a relationship among seemingly unrelated events).
Ability	Information Ordering	The ability to arrange things or actions in a certain order or pattern according to a specific rule or set of rules (e.g., patterns of numbers, letters, words, pictures, mathematical operations).
Ability	Number Facility	The ability to recognize and process numbers quickly and accurately, including performing basic mathematical operations without the use of external aids.
Ability	Working Memory	The ability to temporarily hold information in memory while processing other information.

Table 2. (Continued)

Type	Construct	O*NET Definition
Ability	Speed of Closure	The ability to quickly make sense of, combine, and organize info in a meaningful way.
Ability	Flexibility of Closure	The ability to identify or detect a known pattern (a figure, object, word, or sound) that is hidden in other distracting material.
Ability	Perceptual Speed	The ability to quickly and accurately compare similarities and differences among sets of letters, numbers, objects, pictures, or patterns. The things to be compared may be presented at the same time or one after the other. This ability also includes comparing a presented object with a remembered object.
Ability	Spatial Orientation	The ability to know your location in relation to the environment or to know where other objects are in relation to you.
Ability	Visualization	The ability to imagine how something will look after it is moved around or when its parts are moved or rearranged.
Ability	Selective Attention	The ability to concentrate on a task over a period of time without being distracted.
Ability	Time Sharing	The ability to shift back and forth between two or more activities or sources of information (such as speech, sounds, touch, or other sources).
Ability	Situational Awareness	The ability to track changing information and events in a dynamic environment and assess their impact on the mission. [NOTE: This ability is *not* part of the O*NET taxonomy]
Ability	Control Precision	The ability to quickly and repeatedly adjust the controls of a machine or a vehicle to exact positions.
Ability	Rate Control	The ability to time your movements or the movement of a piece of equipment in anticipation of changes in the speed and/or direction of a moving object or scene.
Skill	Critical Thinking	Skilled at using logic and reasoning to identify the strengths and weaknesses of alternative solutions, conclusions or approaches to problems.
Skill	Complex Problem Solving	Skilled at identifying complex problems and reviewing related information to develop and evaluate options and implement solutions.
Skill	Judgment and Decision Making	Skilled at considering the relative costs and benefits of potential actions to choose the most appropriate one.
Skill	Coordination (Teamwork)	Skilled at adjusting actions in relation to others' actions.

Situational Awareness. At this point, we had not reached a final conclusion on whether to include situational awareness in the list of critical SAOC. Ultimately it was dropped as a target for measurement in the entry-level selection process. While situational awareness can be measured reliably (Carretta, Perry, & Ree, 1996; Endsley & Bolstad, 1994; Matthews & Beal, 2002), it appears to be a function of underlying cognitive processing abilities, several of which are already represented in the critical SAOC list, and knowledge or experience in a particular context or domain. For example, Carretta et al. (1996) found that flying experience was the best predictor of situational awareness among F-15 pilots. In this study, situational awareness was measured through observer (peer and supervisor) ratings. The same study found that scores on measures of general cognitive abilities including working memory, spatial reasoning, and divided attention were predictive of observer ratings of pilot situational awareness. Endsley (1995) developed a theory of situational awareness and defines it as a *state of knowledge.* She differentiates it from the cognitive processes used to achieve it. She further theorizes that factors such as attention, working memory, workload, and stress can influence situational awareness, and that situational awareness is more than the sum of these concepts. Bedney and Meister (1999) argue that Endsley's theory is logically flawed, but agree with her that situational awareness is not a single individual differences construct. They describe it as "part of a cognitive activity that is intensely dynamic."

Situational awareness has been measured using rating scales to collect self or observer ratings (see Bell & Lyon, 2000 for a review; also Carretta et al., 1996; Matthews & Beal, 2002). These measures are typically administered after target subjects perform some complex activity, for example, after a training flight or after a field training exercise. It would be very difficult to collect observer ratings in an entry-level selection process and self-ratings could be easily faked. Situational awareness also has been measured as part of multi-tasking tests and simulations (Endsley & Bolstad, 1994; O'Brian & O'Hare, 2007; O'Hare, 1997; Ramos, Heil, & Manning, 2001a, 2001b). More information is provided about these measures in Appendix B. Some of them treat situational awareness as the composite of performance on several tasks that occur concurrently (e.g., Wombat©; O'Brian & O'Hare, 2007; O'Hare, 1997). Other measures attempt to evaluate situational awareness by stopping a simulation in-progress and posing questions about the state of affairs at that point in time (e.g., Air Traffic Scenarios or Letter Factory Test in the FAA Air Traffic Selection and Training Battery [ATSAT]; Ramos, Heil, & Manning, 2001a, 2001b). The questions might ask the test-taker to identify which objects were present or where they were located in the simulated space, the number of objects of different types that were present, the status of one or more indicators (such as a fuel gauge), and so on. Critics of the latter approach argue that situational awareness is more than the ability to answer questions about information being held in working memory.

Ultimately, we discarded the idea of recommending a measure of situational awareness in the entry-level selection process. However, we do believe that critical aspects of it can be measured using a multi-tasking measure that requires application of working memory, time sharing, and task prioritization. This belief is supported, at least to some degree, by research on situational awareness among pilots (Carretta et al., 1996; Endsley & Bolstad, 1994). For purposes of an entry-level selection battery, we determined that it would be most appropriate to focus on basic abilities that underlie situational awareness, though they likely do not fully capture this important ability.

Table 3. SAOCs Judged to Be Most Critical to RPA Pilot and SO Occupations

Type	Attribute	Definition
Non-Cog	Initiative	To initiate tasks or duties, even difficult ones, without excessive procrastination; to work independently and accomplish tasks without constant supervision; to take personal responsibility for completing work assignments.
Non-Cog	Assertiveness	To speak up and to offer suggestions, recommendations, or opinions when appropriate, even if others may not respond favorably.
Non-Cog	Decisiveness	To make good decisions rapidly, based on available information.
Non-Cog	Self Control	To maintain composure and keep emotions in check, even in very difficult situations; to quickly refocus attention on the primary task after making an error or witnessing an emotionally disturbing event.
Non-Cog	Stress Tolerance	To remain calm, analyze the situation, act appropriately, and make quick, accurate decisions in high workload, time pressure, or other stressful situations.
Non-Cog	Adaptability	To adjust easily to change in situations or unexpected events; to flexibly change one's actions in response to changing task priorities.
Ability	Oral Comprehension	The ability to understand information presented orally in a variety of conditions, including situations in which multiple parties are communicating or under conditions of stress.
Ability	Oral Expression	The ability to communicate information and ideas in speaking so others will understand; the ability to use standard codes to convey information orally.
Ability	Number Facility	The ability to recognize and process numbers quickly and accurately, including performing basic mathematical operations without using external aids (e.g., calculator).
Ability	Working Memory	The ability to temporarily hold information in memory while processing other information.
Ability	Task Prioritization	The ability to perform multiple tasks in order of their importance; to direct attention to tasks when they change priorities (e.g., emergencies).
Ability	Selective Attention	The ability to maintain high levels of concentration on a task in distracting or repetitive conditions; to maintain focus despite interruptions.

Table 3. (Continued)

Type	Attribute	Definition
Ability	Time Sharing	The ability to flexibly switch attention across different tasks; to attend to multiple, potentially conflicting sources of information.
Ability	Perceptual Speed	The ability to quickly and accurately compare similarities and differences among sets of letters, numbers, objects, pictures, or patterns. The things to be compared may be presented at the same time or one after the other. This ability also includes comparing a presented object with a remembered object.
Ability	Spatial Orientation	The ability to know one's location in relation to the environment or to know where other objects are in relation to oneself.
Ability	Visualization	The ability to imagine how something will look after it is moved around or when its parts are moved or rearranged.
Ability	Pattern Recognition	The ability to identify or detect a known pattern (for example, a numerical code); to combine and organize different pieces of information into a meaningful pattern quickly.
Ability	Control Precision	The ability to control the motion of a machine, vehicle, or piece of equipment (e.g., joystick or yoke) quickly and accurately; to make fine, precise movements or adjustments.
Skill	Critical Thinking	Skilled at using logic and reasoning to identify the strengths and weaknesses of alternative solutions, conclusions or approaches to problems.
Skill	Judgment and Decision Making	Skilled at considering the relative costs and benefits of potential actions before choosing the most appropriate action.
Skill	Teamwork Skills	Skilled at coordinating with others in a team setting to accomplish group goals; sharong information to ensure shared understanding of the mission and situation; assisting team members as needed to ensure mission success.

Describing Key Work Context Factors

Adapting to the RPA work context is a critical aspect of the job. The work context provides boundary conditions and the operating context in which job duties will be performed. It can play a critical role in a person's ability or willingness to handle job requirements. As noted earlier, RPA pilots and SOs work in a controlled environment where they monitor multiple video screens, listen to input from multiple audio channels, and communicate with others through email, chat, radios, and telephone. The work is typically performed in shifts and may entail rotating, overnight, and/or long shifts. Teamwork is important, but the core aircrew is small during a shift – a pilot, an SO, and an MC. Pilots and SOs interact closely with each other during the shift, and may interact with a wide variety of others through a variety of communication

channels (except for face-to-face), ranging from the MC, to a ground-based JTAC calling for assistance, to an Army or Marine officer whose troops are under attack, to a high-ranking officer monitoring the overall deployment of RPA resources, to non-military personnel providing intelligence or oversight of a mission. RPA pilots and SOs may experience hours of low activity, requiring self-discipline to maintain vigilance, interspersed with periods of intense activity often characterized as "drinking from a fire hose." Operators are not in any personal physical danger when performing their duties. However, they do experience the visceral effects of combat, for example, witnessing a friendly unit under attack by hostile forces. The duty station for many RPA pilots and SOs is in the continental U.S. (CONUS) and these officers and airmen can return home to their families at the end of shift. However, they may volunteer for or be assigned to temporary duty stations away from their home base, or may be deployed to other parts of the world. Their work is classified, so they are not allowed to talk openly with family or friends about the types of missions that they fly or things that occurred during a mission.

We decided to delineate the work context factors found in most RPA work environments and that, as a whole, make this career field unique. Our starting point is shown in Appendix C. To develop the list shown in Appendix C, we started with information from an existing Army project that defined major work context factors for military jobs (Army O*NET; Russell, Sinclair, Erdheim, Ingerick, Owens, Peterson, & Pearlman, 2008), supplemented by information from early conversations with SMEs, information about the RPA work context provided by the AFPC project team, information found in Bailey (2008) and in front-end analysis reports (Nagy, Eaton, & Must, 2006b; Nagy, Kalita, & Eaton, 2006a), and Internet searches for images and popular press articles about RPAs.

Work context factors are likely to be particularly promising for the development of a new screening measure because, unlike many of the ability and skill constructs found in Tables 2 and 3, they represent dimensions that are largely untapped by existing predictors available to the USAF (e.g., Armed Services Vocational Aptitude Battery [ASVAB], Air Force Officer Qualifying Test [AFOQT], and Test of Basic Aviation Skills [TBAS]). That is, the ASVAB, AFOQT, and TBAS provide good coverage of the cognitive and psychomotor domains. The Self-Description Inventory (SDI+), which is administered experimentally as part of the AFOQT, provides coverage of several non-cognitive work style dimensions. The incremental validity over these existing and established measures provided by any newly developed assessment of ability or work styles could be small. Work context factors, as measured by a Person-Environment fit (P-E fit) assessment or provided as a realistic job preview (RJP), however, offer an opportunity to provide meaningful enhancements to the selection system.

We received a great deal of input on the work context factors from SMEs. This was a topic they enjoyed talking about and one they felt was important for others to understand. The final list of key work context factors, shown in Table 4, was substantially different and much more customized to the RPA work context than our original list. Note that this is not intended to be a comprehensive description of the RPA work environment. Rather, it is intended to capture important aspects of the work context, in particular the negative aspects, that incumbents must be willing to tolerate if making RPAs a career.

Table 4. Key Work Context Factors in the RPA Environment

#	Work Context Statement
	Statements that are characteristic of the RPA work context
1	Make decisions that could have a significant impact on the well-being of others.
2	Work provides opportunities to protect friendly forces with minimal danger to self.
3	A job where one may have to provide negative performance feedback to others.
4	Perform work that involves reconnaissance and surveillance.
5	Work with others at a distance or non face-to-face (e.g., through chat, e-mail, or radio).
6	Required to take action in the face of conflicting or ambiguous directions, orders, or priorities.
7	Work in a setting where others will observe or monitor what you do.
8	Work has a direct, immediate, and visible impact on mission success.
9	Not allowed to talk about work with family or friends.
10	Remain alert and highly-focused for long periods of time, even when there is little happening.
11	Work as part of a team (instead of alone) to get tasks completed.
12	Work involves handling difficult, high-stress, emergency situations.
13	Work in an occupation that is mentally challenging.
14	Take lethal action against enemy targets when authorized to do so.
15	Work may impact the success of combat operations without risk of physical injury.
16	Perform many tasks simultaneously.
17	Able to establish roots in a community due to extended tours of duty in the same location.
18	Work long hours (e.g., 60-80 hours per week).
19	Work with cutting edge aircraft technology.
20	Work can quickly change from boring and routine to very intense and stressful.
21	Work rotating duty shifts.
22	Persuade or influence others over whom you have no authority (e.g., someone at a higher rank).
23	Able to experience flight without experiencing the physical challenges that accompany it (e.g., G-forces or low oxygen levels).

Table 4. (Continued)

#	Work Context Statement
24	Spend most of the work shift in a windowless room, viewing multiple computer monitors.
25	Perform work under significant time pressure.
26	Perform actions that could seriously injure or kill others (non-friendly and friendly).
27	Respond to frequent crises or emergencies.
	Statements that are *NOT* characteristic of the RPA work context (could be used for reverse-scored items in a P-E fit assessment)
28	Able to control the pace and sequencing of own work activities.
29	Able to set own work schedule.
30	Work is repetitive, with very little change in activities from one day to the next.
31	Perform work that is dangerous or could result in serious injury to self. (reverse-scored)
32	Work requires physical hardship (e.g., exposure to elements, sleeping on the ground, eating MRE, no toilet)
33	Afforded opportunities to learn the job from senior co-workers or supervisors.
34	Work allows room for error and learning from mistakes.
35	Perform work that does not require memorizing a lot of details or procedures.
36	Hard to know/determine the effectiveness of your job performance.
37	Perform work where one can be creative.
38	Work that is easy to learn and with few errors.
39	Work alone, with little interaction with or input from others.
40	Work requires travel away from home for extended periods of time (e.g., several months).
41	Perform work that is physically demanding.
42	Work involves few negative consequences if you make a mistake.

Identifying Best Bet Predictor Measures

After we finalized a list of the most critical SAOCs for the RPA pilot and SO occupations and important work context factors, our next step was to think about (a) potential measures of the SAOCs and work context factors and (b) which measures could be bundled into a predictor

battery of reasonable length that would comprise measures appropriate for entry-level selection. We treated these as two separate judgments, first identifying best bet measures for each critical SAOC and then thinking about the most effective and efficient *battery* of predictor measures, taking into account practical constraints on the entry-level selection process.

We started by reviewing available research on RPA operator selection (Bailey, 2008; Biggerstaff et al., 1998; Bruskiewicz, Houston, Hezlett, & Ferstl, 2007; Phillips, 2003; Phillips, Arnold, & Fatolitis, 2003). Each of these studies involve development of entry-level selection tests for pilots of unmanned aircraft only; not for SOs. None are operational yet. Only the study conducted by the Naval Aerospace Medical Research Laboratory (NAMRL) includes any examination of the relationship between scores on predictor and criterion measures appropriate for RPA pilot performance. We attempted to locate information about selection procedures used by other agencies that fly RPAs, such as the Central Intelligence Agency (CIA) or Customs and Border Patrol, but could find only general descriptions (e.g., "must pass an entrance test and be able to obtain a security clearance"). Clearly, there is overlap in the duties and SAOC requirements for manned and unmanned aircraft, so we also reviewed information about measures used for pilot selection, starting with two comprehensive reviews conducted in the past five years (Damos, 2007; Paullin et al., 2006).

U.S. Air Force School of Aerospace Medicine (USAFSAM) Medical Flight Screening for RPA Pilots and SOs

The U.S. Air Force School of Aerospace Medicine (USAFSAM) administers medical flight screening before candidates enter RPA pilot or SO training. The exam includes standardized and clinical evaluations of cognitive functioning, personality, psychopathology, and medical fitness (e.g., vision, hearing, and anthropometric measures). It measures a number of the SAOCs listed in Tables 2 and 3, plus medical and neuropsychological factors that were not considered in the present study. This screening process is used to detect physical or psychological issues that could prevent a candidate from completing training or performing effectively post-training. In other words, this is a *screen out* process.

The focus of the present project was to identify measures that could be administered during the recruitment or accession process, or soon after accession, with the goal of expanding the number of eligible airmen and officers in the RPA training pipeline. In other words, these measures would be part of a *select in* process. Of course, any such candidates would still need to meet all the requirements for entering RPA training, including passing the USAFSAM medical flight screening.

Royal Air Force (RAF) Predator Battery

Bailey (2008) describes efforts to develop and validate a selection battery for UK RAF Predator Pilots. The battery includes subtests designed to assess dynamic processing of visual and auditory information, including building and maintaining situational awareness. It attempts to replicate the kind of cognitive processing tasks that must be performed while flying a Predator. This battery does not purport to tap temperament or P-E fit requirements.

U.S. Navy Unmanned Aerial Vehicle (UAV) Selection Battery

In the mid-1990's, NAMRL was tasked to develop a performance-based selection battery for UAV operators. Biggerstaff et al. (1998) describe development and initial validation of the *Computer-Based Performance Test (CBPT)*. This battery included psychomotor tracking tasks, a dichotic listening test, a measure of mental rotation (Manikin test), and a measure of perceptual speed (Digit Cancellation test). Various subtests are administered concurrently to assess multi-tasking (or time sharing) ability. These researchers conducted a very small-scale validation study based on 8 UAV pilot trainees and reported that the CBPT showed good promise for predicting training performance. According to Phillips (2003), further research stalled due to lack of funding, but was able to locate scores for 39 UAV pilot trainees. Phillips (2003) called the battery the *Psychomotor Test (PMT)* but listed several of the same subtests as described by Biggerstaff et al. (1998) as part of the CBPT. Phillips (2003) and Phillips, Arnold, and Fatolitis (2003) reported strong correlations between PMT scores for 39 UAV student pilots and measures of training performance (mid .40's to mid-.50's) and significant mean score differences between students who did and did not complete the UAV operator training program. Phillips (2003) recommended that the Navy implement a UAV selection battery based on the PMT after upgrading the programming *or* to conduct the necessary research to validate and implement another prototype performance-based measure that also was developed by NAMRL called the *Automated Spatial and Cognitive Abilities Test (ASCAT).* According to Phillips (2003), ASCAT includes several subtests that are the same as or similar to the PMT subtests, but was written in a modern programming language and could be web-enabled. One of the subtests included in ASCAT appears very similar to the Direction Orientation Test that also appears in the USAF Test of Basic Aviation Skills (TBAS). We could not locate any information about the current status of the CBPT, PMT, or ASCAT selection batteries.

U.S. Army Entry-level Selection Battery for RPA Operators

Bruskiewicz et al. (2007) recommended a selection battery for RPA operators based on a taxonomic approach similar to the one taken in this project. To our knowledge, this system is not in operational use (personal communication, Lawrence Katz, October 10, 2009). The research team started with predictor constructs identified as relevant for Army RPA operators and then identified a best bet selection battery, choosing from measures that already exist. Most of the recommended measures are taken from a selection battery that the same research team developed for Army rotary-wing aviators (Army Selection Instrument for Flight Training [SIFT]; Houston & Bruskiewicz, 2006) and which incorporates several cognitive subtests drawn from the U.S. Navy's Aviator Selection Test Battery (ASTB). The recommended battery taps crystalized intelligence (e.g., Reading Comprehension), fluid intelligence (e.g., Spatial Apperception), and perceptual speed and accuracy, and also includes measures of temperament variables (self-report biodata and temperament scales).

Pilot Selection Batteries

We also examined pilot selection batteries currently in use by the U.S. military, or ones not currently in use, but may hold some promise for RPA selection. These selection batteries

clearly measure several of the SAOCs identified as critical for RPA pilots and SOs. Summary information is provided in Appendix B of this report, and several of these batteries are described in more detail in Paullin et al. (2006) and Houston and Bruskiewicz (2006). Briefly, the USAF uses scores on specific AFOQT subtests combined with scores on the TBAS (Carretta, 2005) as part of its pilot trainee selection process. The U.S. Navy uses scores on the ASTB. The U.S. Army developed the SIFT for selection of rotary wing aviators in the mid-2000's (Houston & Bruskiewicz, 2006).

Other Measures that Tap Relevant SAOCs

We located several other test batteries or stand-alone measures that tap SAOCs important for RPA pilots and SOs. For enlisted personnel, one of the primary measures is the ASVAB, which every enlisted applicant must complete at the time of enlistment. Many of the existing test batteries, including the ASVAB, contain several measures of crystalized intelligence (Carroll, 1993; Horn, 1965; Horn & Noll, 1997), such as verbal and numerical reasoning and reading comprehension and vocabulary. Increasingly, entry-level test batteries also include measures of fluid intelligence, such as measures of spatial ability, nonverbal or figural reasoning, and working memory.

Several military research efforts have focused on developing measures to tap psychomotor and cognitive processing constructs. Examples include the USAF Basic Attributes Test (BAT) (Carretta, 1987), which was replaced by TBAS (Carretta, 2005), and a joint effort by the U.S. Army and the U.S. Navy to develop the Enhanced Computer-Administered Test (ECAT) battery that incorporates measures of perceptual speed and accuracy, spatial and inductive reasoning, and psychomotor skills (Alderton, Wolfe, & Larson, 1997; Russell, Peterson, Rosse, Hatten, McHenry, & Houston, 2001). Embretson (1998) developed the Abstract Reasoning Test (ART) which demonstrated good construct validity when administered to samples of USAF recruits. Currently, the U.S. Department of Defense is considering including the ART or the ECAT figural reasoning test in the ASVAB (Drasgow, Embretson, Kyllonen, & Schmitt, 2006).

Ackerman and colleagues conducted a series of research studies to explore the domains of psychomotor skills and perceptual speed. They developed PC-based measures of both psychomotor and perceptual speed, taking advantage of advances in computer software and hardware (e.g., touch screens) but also using standard peripheral equipment that should be readily available (e.g., light pens) (Ackerman, 2004; 2007; Ackerman, Beier, & Boyle, 2002; Ackerman & Cianciolo, 2000; Ackerman & Beier, 2007).

The U.S. Navy has also developed performance-based measures that, to date, have only been used for experimental research, including a block rotation task and a two-dimensional compensatory tracking task (Fatolitis, Jentsch, Hancock, Kennedy, & Bowers, 2010). It has also used a measure, called SYNWORK in early versions (Elsmore, 1994) and SYNWIN in later versions (Oswald, Hambrick, Jones, & Ghumman, 2007), to measure multi-tasking performance. To date, this multi-tasking measure has been used as a *criterion* against which other predictor measures were validated (Branscome & Grynovicki, 2007; Oswald et al., 2007), but we examined it as a possible predictor measure.

The Federal Aviation Administration's (FAA) Air Traffic Selection and Training (ATSAT) battery measures skills and abilities necessary to process dynamic information presented on two-dimensional displays, with a strong component of spatial orientation and visualization, while at the same time communicating through audio channels with external parties (King, Manning, & Drechsler, 2007; Ramos, Heil, & Manning, 2001a, 2001b; Wise, Tsacoumis, Waugh, & Putka, 2003; Wise, Tsacoumis, Waugh, Putka, & Hom, 2001). Several of the subtests within this battery measure SAOCs required for RPA pilots and SOs. Carretta and King (2008) administered the ATSAT to USAF enlisted personnel who were training to become air traffic controllers (ATC). They found that an ATSAT subtest that simulates some aspects of the ATC job provided incremental validity beyond the ASVAB in predicting ATC training outcomes. However, they were hesitant to recommend that the USAF begin administering this subtest operationally because it required 95 minutes of testing time and, when combined with the ASVAB, increased mean subgroup score differences.

In the non-cognitive arena, there are existing measures of several different types of constructs including:

- personality and temperament constructs, for example, the USAF SDI+ (Metrica, 1997; Weissmuller & Schwartz, 2008), the U.S. Army Rational Biodata Inventory (RBI; Kilcullen, Mael, Goodwin, & Zazanis, 1999; Kilcullen, White, Sanders, & Hazlett, 2003), and the U.S. Army Assessment of Individual Motivation (AIM; White & Young, 1998; White, Young, & Rumsey, 2001)
- vocational interests, for example, the USAF Vocational Interest-Career Exploration (VOICE; Alley & Matthews, 1982). the U.S. Navy Job Opportunities in the Navy (JOIN; Alley, 2000; Chen & Jones, 2008; Farmer, Bearden, Fedak, et al., 2006), or the U.S. Army Work Preferences Assessment (Van Iddekinge, Putka, & Sager, 2005), and
- values, for example, the U.S. Army Work Values Inventory (Van Iddekinge, Putka, & Sager, 2005).

Several service branches are currently exploring new approaches to measuring non-cognitive characteristics in an attempt to overcome faking concerns associated with self-report instruments, for example, the Navy Computer Adaptive Personality Scales (NCAPS; Borman, Schneider, & Houston, 2009; Houston, Borman, Farmer, & Bearden, 2006) and the Army Tailored Adaptive Personality Assessment System (TAPAS; Heffner, White, & Owens, 2010; Stark, Chernyshenko, & Drasgow, 2010). The SDI+, NCAPS, and TAPAS are measures of the Big Five personality constructs.

Best Measure(s) for Each SAOC

As expected, we found existing, proven measures for many of the most critical SAOCs, including several that the Air Force already owns and uses. Appendix B summarizes information about several such measures, some of them bundled into test batteries and some of them measures of a single SAOC. We also created an SAOC by predictor matrix, shown in Table 5, which includes a "best bet" existing predictor as well as one or more alternate predictors for each SAOC–where we were able to find them. We focused first on identifying measures already in use by

the Air Force. For example, the AFOQT and SDI+ are administered in the USAF officer commissioning process and the ASVAB is administered in the enlistment qualification process. These two multi- scale test batteries provide coverage of several critical SAOCs (although faking could be a concern when the SDI+ is used for high-stakes selection purposes). The USAF already administers the TBAS as part of the screening process for officers who want to become pilots and it has also been administered experimentally to enlisted personnel. We also identified several alternate measures that should be available to the USAF, either because they were developed with Air Force research funding (e.g., PC-based measures of psychomotor skills and perceptual speed [Ackerman, 2004]) or because they are owned by other U.S. military service branches (e.g., the U.S. Army SIFT or the U.S. Navy ASTB).

We did not include the UK RAF Predator battery in Table 5 because it was not complete at the time of this project (Bailey, 2008). When the UK RAF Predator battery is complete, it may provide a viable option, though we believe it would need to be supplemented with some measures of non- cognitive SAOCs. Similarly, we excluded the measures that are part of the medical flight screening battery used by USAFSAM. We are not trying to replace or pre-empt the medical flight screening process, so we did not want to build any redundancy into the selection process. We included the ECAT measures but note that the programming for at least some of these tests would need to be updated before they could be used operationally. We also included the NCAPS scales as alternates for several of the non-cognitive SAOCs, but note that they have not yet been fully approved by the Navy for operational use. Finally, we included several TAPAS scales but note that the number of TAPAS scales and their labels have changed over time and will likely continue to do so.

If the USAF decides to pursue an RPA-specific entry-level screening system, it will need to consider the feasibility of administering a computer-based assessment that includes special equipment (e.g., joystick and rudder pedals required for TBAS) or the feasibility of administering a test currently used for one population (e.g., officers) in a different population (e.g., enlisted).

Measurement Gaps

As shown in Table 5, the critical SAOCs for which there is a clear measurement gap include Oral Expression Skills and Judgment and Decision Making. In addition, there is no existing P-E fit measure customized to the RPA work context. For each of the other SAOCs, there is an existing measure that provides at least a reasonable degree of coverage. However, some of the measures are less than a perfect fit. The gap analysis assumes that it would be feasible to administer any of the measures to both an enlisted and an officer population, however this assumption may be a stretch. For example, it may or may not be possible to administer TBAS to *all* enlisted personnel. Another potential issue with TBAS is that one of the two tracking tasks involves rudder pedals. In the RPA context, only the pilot uses rudder pedals, so it may be necessary to create a second version of this tracking task that involves a trackball rather than rudder pedals (because SOs use a trackball). Finally, TBAS provides a measure of Time Sharing ability, but does so by combining psychomotor tasks with cognitive processing tasks. A purer measure of Time Sharing ability would combine only cognitive processing tasks. Beyond TBAS, some of the best bet assessments are commercially-available instruments for which there would be licensing or usage fees, and we do not know if the Air Force would be willing to pay

such fees for large-scale testing programs. Where the only option was a commercially-available instrument, we used the label "Maybe" in the gap column.

Table 5. Best Bet Existing Measures for Each Critical SAOC

Type	SAOC	Best Bet Existing Air Force-owned Predictor	Alternate Predictor(s) that the Air Force Could Likely Access	Gap?
Non-Cog	Initiative	SDI+ Conscientiousness Factor score (officer)	TAPAS Achievement scale NCAPS Achievement Striving & Self-Reliance scales	No
Non-Cog	Assertiveness	SDI+ Extroversion Factor score (officer)	TAPAS Dominance Scale NCAPS Leadership Orientation	No
Non-Cog	Decisiveness	SDI+ Extroversion Factor score (officer)	TAPAS Dominance Scale NCAPS Leadership Orientation	No
Non-Cog	Self Control	SDI+ Emotional Stability Factor score (officer)	TAPAS Even-Tempered scale NCAPS Self-Control/Impulsivity	No
Non-Cog	Stress Tolerance	SDI+ Emotional Stability Factor score (officer)	TAPAS Adjustment scale NCAPS Stress Tolerance scale	No
Non-Cog	Adaptability	SDI+ Emotional Stability Factor score (officer)	NCAPS Adaptability/Flexibility scale Army Adaptability Measures	No
Ability	Working Memory	TBAS Directed Listening test	ECAT Mental Counters or Sequential Memory test	No
Ability	Task Prioritization	TBAS Emergency Scenarios	ATSAT Letter Factory or Air Traffic Scenarios tests	No
Ability	Selective Attention	TBAS Emergency Scenarios to a limited extent	ATSAT Letter Factory or Air Traffic Scenarios tests	No
Ability	Time Sharing	TBAS Directed Listening + Tracking Tasks	ATSAT Letter Factory or Air Traffic Scenarios tests; SYNWIN	No
Ability	Perceptual Speed	AFOQT Table Reading test (officer)	Army SIFT battery: PS&A Simple Drawings subtest; PC-based measure of Perceptual Speed; ATSAT Dials Test	No
Ability	Spatial Orientation	TBAS Direction Orientation Test	ECAT Spatial Orientation; ASTB Spatial Apperception	No
Ability	Visualization	AFOQT Block Counting & Rotated Blocks (officer) ASVAB Assembling Objects (enlisted)	NAMRL Block Rotation Test or Manikin Tests	No

Table 5. (Continued)

Type	SAOC	Best Bet Existing Air Force-owned Predictor	Alternate Predictor(s) that the Air Force Could Likely Access	Gap?
Ability	Pattern Recognition	AFOQT Hidden Figures test (officer) ASVAB Assembling Objects (enlisted) [gets at the higher-order spatial ability factor]	PC-based measure of Perceptual Speed-Pattern Recognition	No
Ability	Oral Comprehension	TBAS Directed Listening test (weak measure)	None	No
Ability	Oral Expression	None	None	Yes
Ability	Number Facility	AFOQT Arithmetic Reasoning (officer) ASVAB Arithmetic Reasoning (enlisted) (These measures do not necessarily capture the dynamic way in which this ability is used in the RPA work context)	ASTB Mathematical Ability; PC-based measure of Perceptual Speed - Factors of 7	No
Ability	Control Precision	TBAS Vertical Tracking Test (VTT) & Airplane (Horizontal Tracking) subtests	ECAT One-Hand & Two-Hand Tracking; NAMRL ASCAT Control Reversal Test; Mirror or Maze Tracing PC-based psychomotor tests, but would need research to determine if the response modality (light pen or touch screen) is similar enough to tracking tools used in RPA Ground Control Stations	No
Skill	Critical Thinking	None	Watson-Glaser Critical Thinking Appraisal	Maybe
Skill	Judgment and Decision Making	None	None	Yes
Skill	Teamwork Skills	SDI+ Team Scale (officer)	Teamwork Knowledge, Skills and Ability Test	No
P-E Fit	RPA Work Context Features	None	None	Yes

We presented our preliminary recommendations to the AFPC project team. They were already very knowledgeable about most of the measures listed in Table 5. Our discussion focused on (a) potential measurement gaps, (b) identifying SAOCs that would most appropriately be measured in an *entry-level* selection process, and (c) practical constraints on the number and type of assessments that could be measured. After discussion, we reached consensus that several of the critical SAOCs need not or should not be given further consideration at this time. Our rationale is provided below. Finally, we decided to consult with RPA SMEs on several existing measures of Time-Sharing ability, to collect their views of the extent to which these measures adequately capture critical aspects of Time Sharing as it occurs in the RPA context.

Oral Comprehension and Oral Expression Skills

SMEs told us RPA pilots and SOs must be able to quickly comprehend call signs and other cryptic messages that may be arriving through the audio channel, while they are also devoting some of their attention to other tasks. SMEs also indicated that the most critical aspect of oral expression is learning and accurately using the shorthand speech required to communicate efficiently and effectively with their aircrew partners and with outside entities. Many SMEs indicated that "communication skills" are especially important for RPA SOs, but further probing revealed that the critical SAOC is not communication skills, *per se*, but having the assertiveness to speak up and question the pilot (who is an officer), for example, when he/she seems on the verge of making an error. Learning to comprehend call signs and to speak in the type of shorthand required by the RPA job is something that can be learned after hire. Being willing to speak up to a higher-ranking person is captured by the Assertiveness SAOC.

We spent some time searching for existing measures of communication skills, and these are summarized in Appendix B. We found that most are designed for business-like settings in which oral communication skills are important for doing briefings or sales presentations or delivering a training session. None emulated the type of oral comprehension and oral expression skills that are unique to the RPA work environment.

Critical Thinking Skills

We spent time considering this skill because it seems important for all Air Force officers and enlisted personnel, including RPA pilots and SOs. Watson and Glaser (1994) were the first to define a concept they labeled "critical thinking skills" and developed a measure that is still in use today (Watson & Glaser, 2009). They define critical thinking as attitudes, knowledge, and skills that, together, are required to understand (a) that factual statements or arguments must be supported by some kind of evidence and (b) how to evaluate the relevance, accuracy, and reliability of such evidence. Scores on the *Watson-Glaser Critical Thinking Appraisal II* (Watson & Glaser, 2009) are correlated in the .45-.65 range with other measures of cognitive ability and in the .25-.35 range with some measures of Openness to Experience. A few other test publishers provide similar measures. In a series of studies conducted by the U.S. Army Research Institutes for the Behavioral and Social Sciences (ARI), critical thinking was treated as a skill that could be trained, and researchers developed a tool called the Computerized Training in Critical Thinking (CT^2) (Fischer, Spiker, Harris, McPeters, & Riedel, 2008). This training approach is consistent with calls by education experts and other commentators for stronger and

more widespread training in critical thinking skills for both children and adults (e.g., Brookfield, 1987; Facione, Facione, & Giancarlo, 2000; Sternberg, 1986). It appears that critical thinking skills are somewhat domain-specific (the knowledge component of the definition) and they may also be trainable. As trainable skills, they need not be a high-priority target for entry-level selection. Finally, we were concerned that measures of critical thinking skills might not provide enough incremental validity beyond measures of fundamental cognitive abilities to be worth the extra administration time.

We located several potential measures of critical thinking skills, as shown in Appendix B. For the reasons just cited, we did not recommend this type of measure for further consideration.

Judgment and Decision Making Skills

Judgment and decision making skills are typically measured through structured interview questions or through scenario-based assessments that provide some context in which judgment must be applied and decisions made. Situational judgment tests (SJTs) have been used for this purpose (Weekly & Ployhart, 2006) as have live or virtual role play and in-basket exercises (Thornton & Rupp, 2004; Tsacoumis, 2007). A customized, computer-administered SJT or virtual role play could be developed to measure general judgment and decision making skills, and these measures could be customized to be face valid for the RPA work context. In the RPA work context, decisions often must be made under time pressure and there may not be time to formulate and evaluate several alternatives, as in the classic sense of judgment and decision making. A customized SJT or virtual role play could emulate at least some of the speeded aspects of judgment and decision making as it occurs in the RPA work context. We did not find any viable measure of speeded, contextualized judgment and decision making, so we did not pursue this gap further, but note that it could be an area for further research.

Teamwork Skills

There are stable individual differences in preferences for working in teams versus alone, and in levels of agreeableness and cooperativeness that facilitate team processes. These qualities can be measured with existing tools, such as the SDI+, TAPAS, or NCAPS. Stevens and Campion (1999) developed and validated a scenario-based test of teamwork knowledge, skills, and abilities (KSAs) that has proven predictive of team-oriented job performance in their own research and in that of others (McClough & Rogelberg, 2003). A promising aspect of the Teamwork KSA Test is that it should be less vulnerable to faking than self-report inventories that tap preferences and attitudes. Therefore, the Teamwork KSA test provides a viable alternative if concerns about faking limit the use of self-report measures of teamwork preferences and attitudes. However, it is also possible that this test would overlap considerably with existing measures of cognitive ability or teamwork preferences and attitudes. Stevens and Campion (1999) found incremental validity for the Teamwork KSA test beyond that shown by an employment aptitude battery in one study, but not in another study. Given that the test would require more than 30 minutes of testing time and concerns that it might not add any predictive value, we decided not to consider this measure further at this time.

Time Sharing

As shown in Table 5, we identified several existing measures of Time Sharing that should be accessible to the Air Force: (a) TBAS combinations of tracking and listening tasks, (b) ATSAT Letter Factory Test, (c) ATSAT Air Traffic Scenarios Test, and (d) SYNWIN. We did not include the NAMRL tests because we could not get a clear sense for the current status of these measures, for example, whether or not they have been programmed in modern programming languages. In August 2010, we conducted focus groups with several RPA SMEs, in which we provided descriptions and screen shots of the various measures. (It was not possible to provide live demonstrations.) The SMEs included four experienced ANG RPA pilots, four experienced ANG RPA SOs, and one contractor who has flown RPAs and has trained RP A pilots. The SMEs felt some aspects of each measure reflected RPA time sharing requirements, while other aspects did not. Their comments are summarized in Figure 3.

<u>Things TBAS gets right:</u>

- Doing more than one thing at once
- Audio coupled with vertical tracking is somewhat realistic (though not tracking another aircraft); occasionally having to deal with an emergency

<u>Things TBAS does not get right:</u>

- Horizontal tracking is only relevant for RPA pilots who do launch and recovery.
- Stick-and-rudder skills are not the most critical aspects of multi-tasking, particularly for pilots who are not involved in launch and recovery. This test emphasizes those skills.
- Tracking other aircraft in crosshairs

<u>Things the ATSAT Letter Factory Test gets right:</u>

- Continual monitoring of things that are changing/moving
- Must keep ahead of the system, by being required to order boxes
- Quality control, noticing a problem and taking action
- Situational awareness questions, particularly if they get at *spatial* awareness of what was going on in the workspace when it disappeared
- Task saturation can increase with change in pace of belts or number of errors, etc.

<u>Things the ATSAT Letter Factory Test does not get right:</u>

- No audio component
- No altitude or 3rd dimension component
- No tracking component

<u>Things the ATSAT Air Traffic Scenarios Test gets right:</u>

- Requirement to understand and deal with headings, altitude, and speed
- Requirement to think in 3 dimensions
- Prioritization is embedded in the external environment (e.g., have to quickly determine which plane must have attention right now, which ones can wait a little while)
- Requirement to monitor aircraft to ensure instructions were received accurately
- Need to “stay ahead”

- Multiple aircraft in the same space moving at different speeds; must perform tasks both quickly and accurately
- Screen display is a little like FalconView
- Monitoring position (distance, heading, and altitude) of other aircraft, as well as their speed
- Monitoring something that is dynamic and constantly changing

<u>Things the ATSAT Air Traffic Scenarios Test does not get right:</u>

- No audio component
- No tracking (as with a joystick or trackball) component
- Landing fields are not accurate, but concept that there is something stationary on the ground is okay

<u>Things the SYNWIN test gets right:</u>

- Several things happening at once, with a mix of monitoring and actively doing something (e.g., solve math problems)
- Audio component, with only some of the information relevant
- Better if you can perform tasks both quickly and accurately
- Monitoring fuel gauge is face valid
- Simulates checking on operations while handling emergency procedures and getting audio messages
- Constantly scanning, some activities require more attention than others, some are more active than others
- Math part simulates calculating a fuel plan
- Audio component, with only some of the information relevant
- Shows that you can do other stuff all the time

<u>Things the SYNWIN test does not get right:</u>

- No psychomotor tracking component
- No clear requirement to prioritize tasks

Figure 3. Summary of RPA SME comments on measures of time sharing ability.

We also considered the length of each of the preceding measures of Time Sharing ability, its face validity, and its likely availability to the USAF. Given that TBAS is already administered to officer pilot candidates and to at least some enlisted personnel, we recommend continuing to administer it. However, we note that the tracking task that uses rudder pedals is not an accurate representation of psychomotor skills used by RPA SOs. The ATSAT Air Traffic Scenarios subtest is lengthy, requiring more than 90 minutes to administer. Thus, it does not seem viable for inclusion in an entry-level selection process. The ATSAT Letter Factory Test is also lengthy to administer and SMEs felt its lack of face validity was problematic. SYNWIN garnered positive reactions and requires less administration time than the ATSAT subtests. SMEs noted that SYNWIN does not include a significant psychomotor component, but that is exactly the type of measure we were seeking. We contacted Navy researchers to find out if the SYNWIN code would be available to the Air Force, with no success. Therefore, we recommended programming an Air Force-owned measure that would bear surface similarities to SYNWIN, but would also be programmed in a flexible modular format that the Air Force could change the type of tasks that must

be performed concurrently.

Best Bet Predictor Battery

After identifying best-bet predictors for each SAOC, including possible measurement gaps, our next challenge was to recommend a *battery* of predictors that could potentially be administered in an entry-level selection process. We knew that we had to work within practical constraints, given that thousands of potential candidates would need to complete the battery, and potentially at many different locations. The first practical consideration was assembling a predictor battery that would require little or no change to existing entry-level selection *administration* procedures. For example, it would not be realistic to suggest a battery requiring specialized equipment or hand scoring of verbal or written responses or the presence of external observers. We also learned from the Air Force Recruiting Service that it would not be realistic to ask recruiters to administer and score assessments. Therefore, we assumed that any new measures would need to be administered on existing testing platforms using existing procedures (e.g., TBAS, AFOQT, and ASVAB). We did, however, consider the possibility of making a P-E fit measure available as a self-assessment on an Air Force recruiting website, rather than as an actual screening or selection tool.

The second practical consideration was assembling a predictor battery that could be administered in a reasonable amount of time. For example, we knew it would be impractical to measure *all* of the critical SAOCs because doing so would require several hours of testing time per examinee. We gave highest priority to a battery of assessments that would measure fundamental SAOCs least likely to be impacted by post-enlistment/post-accessioning training.

The third practical consideration was taking advantage of the voluminous research that the Air Force and the other services have already devoted to developing entry-level selection measures. As shown in Table 5, there are existing, well-researched measures that tap many of the SAOCs critical for RPA pilots and SOs. It would not be realistic to propose replacing these measures with others that might add little to overall prediction of success in the RPA career fields. Therefore, we gave higher priority to assessments already owned by the USAF or Department of Defense than to commercially-available assessments or assessments that would likely be costly or difficult for the USAF to access.

We took two approaches when thinking about a best bet predictor battery. The first approach focused on making maximal use of existing predictor measures readily available to the USAF. This battery would be the easiest to implement. The second approach focused on identifying a battery of existing measures likely to demonstrate smaller gender subgroup differences than existing batteries such as the AFOQT or ASVAB. The second approach takes advantage of rigorous research on non-verbal measures of cognitive ability (see Waters, Russell, & Sellman, 2007 for a review), measures of spatial and psychomotor abilities (e.g., Ackerman & Cianciolo, 2000; Alderton et al., 1997; Russell et al., 2001), and measures of perceptual speed (Ackerman, 2004; Ackerman & Beier, 2007). Table 6 shows our final recommendations.

__Table 6. Recommendations for an Entry-level RPA Pilot and SO Predictor Battery__

Option 1: RPA Pilot AFOQT -- Arithmetic Reasoning -- Table Reading -- Block Counting -- Rotated Blocks -- Hidden Figures -- SDI+ TBAS New measure of Time Sharing ability that can be administered on the TBAS platform New P-E fit measure customized for RPA environment	**Critical SAOCs covered by this battery:** Initiative Assertiveness Decisiveness Self-Control Stress Tolerance Number Facility Working Memory Task Prioritization Selective Attention Perceptual Speed Pattern Recognition Spatial Orientation Visualization Oral Comprehension Control Precision
Option 1: RPA Sensor Operator ASVAB -- Arithmetic Reasoning -- Assembling Objects TAPAS TBAS (if possible, replace rudder with trackball) ECAT Mental Counters or Army SIFT or PC-based measure of perceptual speed New measure of Time Sharing ability that can be administered on the TBAS platform New P-E fit measure customized for RPA environment	**Critical SAOCs covered by this battery:** Initiative Assertiveness Decisiveness Self-Control Number Facility Working Memory Task Prioritization Selective Attention Perceptual Speed Pattern Recognition Spatial Orientation Visualization Oral Comprehension Control Precision
Option 2: For Both RPA Pilots and Sensor Operators ECAT Figural Reasoning or Abstract Reasoning Test (ART) ASVAB Assembling Objects test TAPAS TBAS Tracking subtests (perhaps replacing rudder pedals with trackball) or a PC-based psychomotor test ECAT Mental Counters or Army SIFT or PC-based measure of perceptual speed New measure of Time Sharing ability that can be administered on the TBAS platform New P-E fit measure customized for RPA environment	**Critical SAOCs covered by this battery:** Initiative Assertiveness Decisiveness Self-Control Number Facility Working Memory Task Prioritization Selective Attention Perceptual Speed Spatial Orientation Pattern Recognition Visualization Control Precision

Summary of Predictor Battery Recommendations

Each recommended test battery covers most of the critical SAOCs identified in Table 3, but not one covers all of them. The SAOCs that were dropped from further consideration, including oral expression, oral comprehension, critical thinking skills, judgment and decision making skills, and teamwork skills are not covered in any of the batteries. Each battery also covers all of the major taxonomic domains, including cognitive abilities and skills, work style (temperament) characteristics, cognitive processing abilities and skills, and psychomotor skills. Option 1 makes maximal use of existing measures for both RPA pilots and SOs while Option 2 replaces some of the current operational measures with measures that demonstrated acceptable levels of validity and smaller gender subgroup differences than some of the existing measures.

For RPA Pilots, the core of the Option 1 battery includes the same assessments that are already used in manned aircraft pilot training candidate selection. It includes a composite of scores on the AFOQT subtests and TBAS. The AFOQT subtests recommended for selection of RPA pilots do not mirror the existing AFOQT Pilot composite. At this point, our recommendations for an RPA pilot composite of AFOQT scores is based on mapping SAOC requirements against the AFOQT subtests. Obviously, research would be required to determine the appropriate weighting of the subtest recommended for the RPA pilot composite and to determine if it provides any improvement in prediction over the existing AFOQT Pilot composite. A new measure of Time Sharing ability could be incorporated into the TBAS platform with relative ease because no new hardware or peripheral equipment would be required. A new RPA-specific P-E fit measure could be administered in conjunction with the TBAS or it as a self-assessment available to officer candidates prior to joining the Air Force.

The Option 1 battery for RPA SOs includes two measures that are already administered at Military Entrance Processing Stations (MEPS) and Military Enlistment Test Sites (METS)–the ASVAB and the TAPAS.[3] TBAS is currently administered to enlisted personnel as they attend BMT at Randolph AFB and, as noted above, the newly-developed measure of Time Sharing ability could be administered on the same platform. One unknown about this battery is whether or not it is feasible to administer several of the measures post-enlistment, and then use the results to support career field changes for enlisted personnel who have already been assigned to an AFS other than 1U0X1, Unmanned Aerospace System (UAS) Sensor Operator. The new RPA-specific P-E fit measure could either be made available as a self-assessment prior to enlistment or administered on the TBAS platform.

The Option 2 battery is the same for RPA pilots and SOs. It replaces existing multi-aptitude test batteries – the AFOQT and ASVAB – with cognitive ability measures that focus more heavily on fluid intelligence (nonverbal reasoning and spatial abilities). These measures have shown promise for predicting important outcomes in prior studies (e.g., training or job performance), but are not currently used for operational selection by the U.S. military. Figural reasoning tests have also demonstrated smaller gender subgroup score differences and, sometimes, smaller race/ethnic subgroup score differences than some of the more traditional cognitive ability tests (Russell et al., 2001; Waters, Russell, & Sellman, 2007). The ASVAB

[3] TAPAS is currently under trial for operational use in U.S. Army enlisted selection. The USAF is conducting a study to evaluate the validity of TAPAS for prediction of performance in a variety of AFSs.

Assembling Objects test has also demonstrated smaller gender differences than many other measures of spatial ability. To create this battery, the USAF would need to obtain the necessary permissions and determine which measures should be administered on which platform(s). TAPAS is already administered on the CAT-ASVAB platform at the MEPS and the ART may also be available there soon. The other measures could potentially be incorporated in the TBAS testing platform.

Development and Beta Testing of a New Measure of Time Sharing Ability

As noted above, we decided to develop a measure of Time Sharing ability that is similar in appearance to SYNWIN. HumRRO partnered with Aptima, Inc. to develop and program a multi-tasking (MT) test that provides a great deal of flexibility for changing test parameters and for adding different tasks in the future. Currently, it includes four simple tasks, each of which is easy to perform by itself. Test-takers are provided instruction on and an opportunity to practice performing each task independently, and then practice performing all four tasks concurrently before completing the operationally scored section of the test. The number and length of the practice trials is a variable parameter, meaning that the AFPC can change the parameters prior to any particular instance of testing. The MT test also has the flexibility to change virtually any parameter in the tasks themselves, such as the rate at which stimulus objects appear, the number of digits in a math problem, the score values assigned to correct and incorrect responses, and the way in which a non-response is treated. Once the parameters are set, it is expected that they will remain the same for all test-takers until an authorized test administrator changes them. We believe this tool can provide a foundation for extensive future research on Time Sharing ability, in addition to providing a selection instrument for RPA pilot and SO career fields. More detail is provided about this measure below, as well as in the Installation and Configuration Guides that were delivered to the AFPC project team.

Overview of the Multi-Tasking (MT) Test

The USAF MT Test assesses an individual's skill in performing multiple tasks simultaneously. Scores on the MT Test are intended to be used to qualify an individual for entry-level job(s) requiring multi-tasking skills. In its current configuration, the MT Test (Figure 4) consists of the following four tasks:

- Memorization Task (upper left-hand quadrant)
- Basic Math Skills Task (upper right-hand quadrant)
- Visual Monitoring Task (lower left-hand quadrant)
- Listening Task (lower right-hand quadrant)

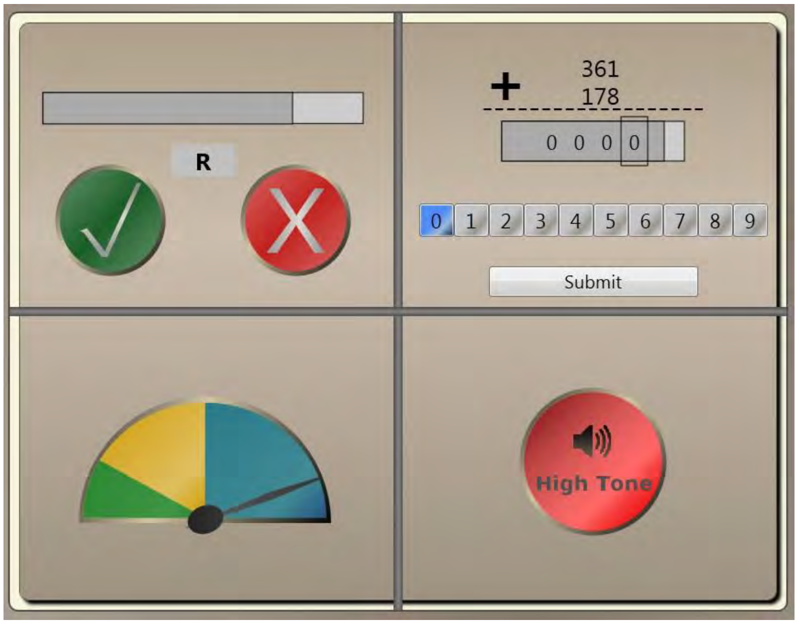

Figure 4. Screenshot of the MT test.

Memorization Task

What Must the Examinee Do?

- Memorize a series of letters that are briefly presented, then removed. Then, after a brief delay, indicate if the target letter shown matches one of the series in the series, now hidden.
- Earn points for correctly answering ✓ ("Yes") or X ("No") that the target letter shown matches one from the memorized series.
- Lose points for incorrectly matching the target letter to the now hidden series or for failing to respond before time expires. Examinees also lose points every time they re-display the series.

How Does the Task Work?

- A series of letters is shown in the top box (Figure 5). The test-taker has a brief period to memorize the list before it is hidden.

Figure 5. Memorization task item – list shown.

- The series is then hidden and is replaced by the words “Retrieve List (Lose Points)” (Figure 6). Clicking “Retrieve List (Lose Points)” will re-display the series of letters. However, examinees lose points every time they click “Retrieve List.”

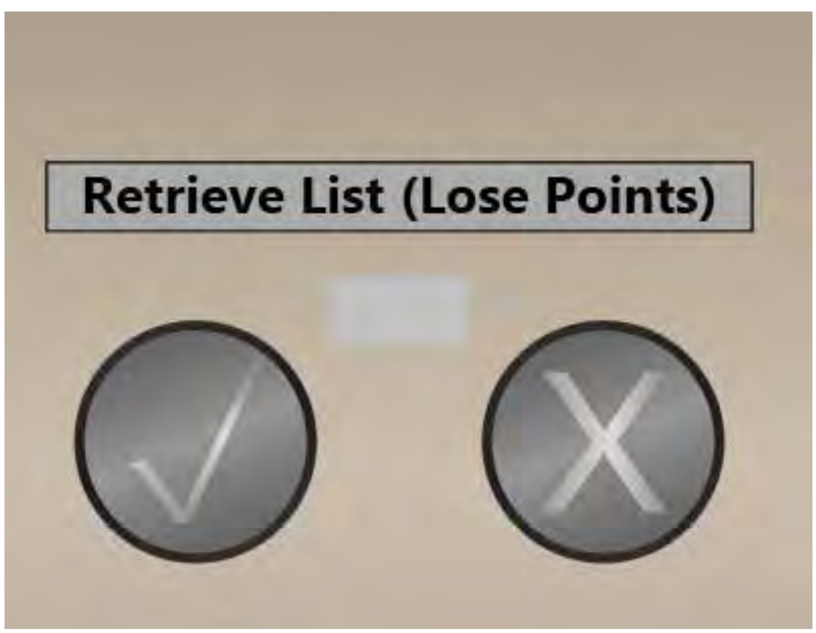

Figure 6. Memorization task item – list hidden.

- After another brief delay, a target letter appears in the middle box.

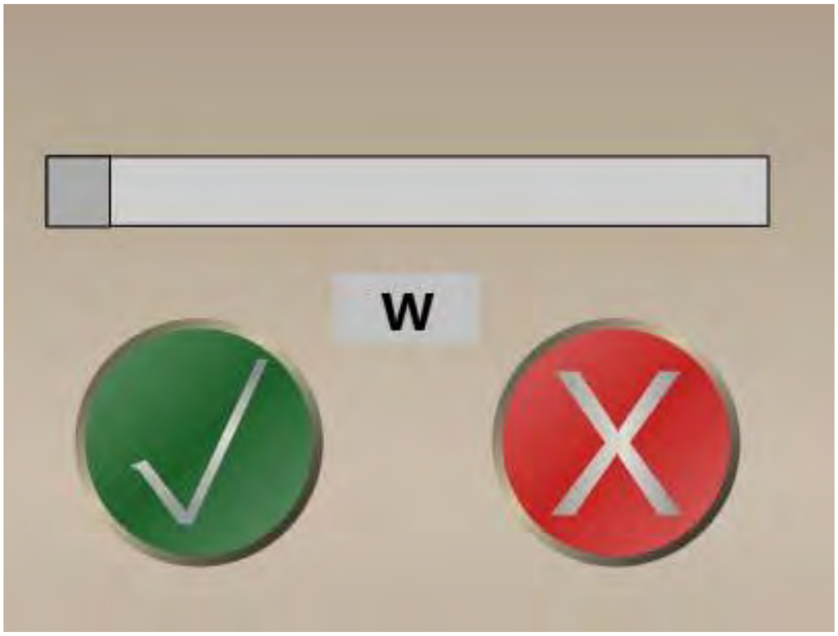

Figure 7. Memorization task item – target letter instance.

The test-taker then has a specified period to indicate if the target letter shown matches one of the letters in the series, now hidden. The test-taker clicks ✓ (“Yes”) if the target letter did appear in the series. He or she clicks “No” if the letter did not. A progress bar running across the top box shows the examinee how much time remains to answer.

After the examinee responds or time expires, there is brief delay before a new Memorization item is presented. During this time the test-taker can concentrate on one or more of the other tasks.

Basic Math Skills Task

What Must the Examinee Do?

- Solve addition or subtraction problems.
- Earn points for correctly solving a problem.
- Lose points for answering incorrectly or failing to solve a problem before time expires.

How Does the Task Work?

- A math problem (addition or subtraction) is presented (Figure 8). Immediately below the problem is the answer line where an examinee’s answer is displayed.

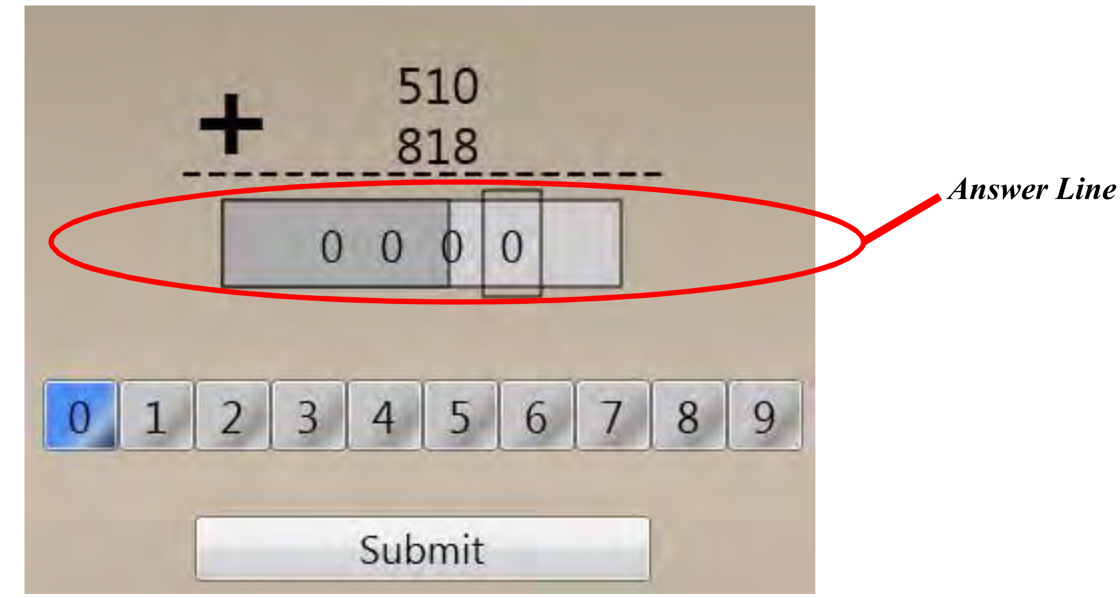

Figure 8. Basic math skills item – answer line highlighted.

- Below the answer line is a row of number buttons (0-9) (Figure 9). The examinees use these buttons to enter their answers.

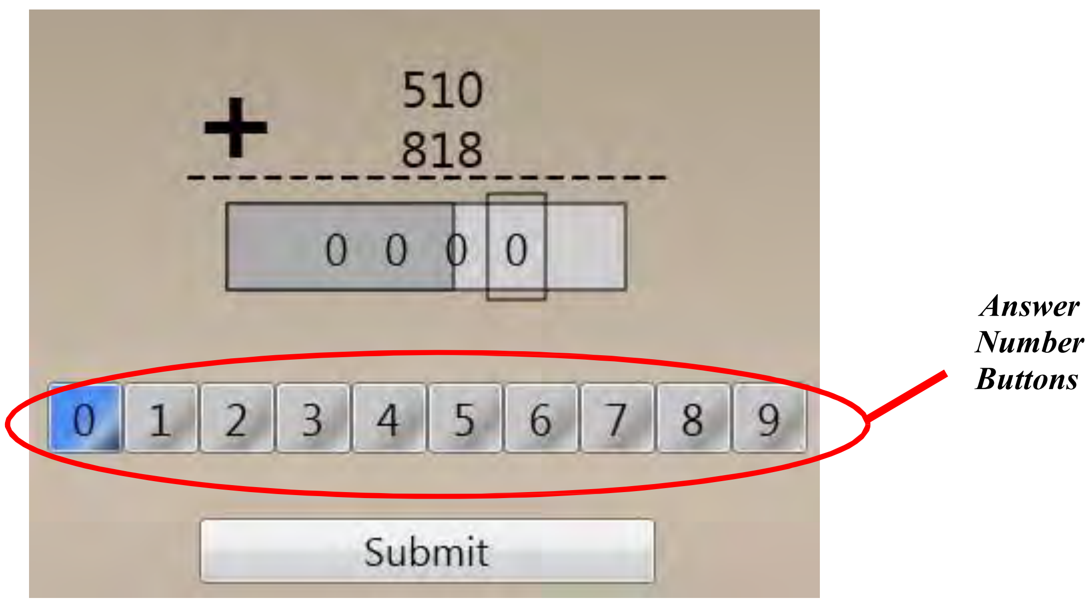

Figure 9. Basic math skills item – answer number buttons highlighted.

- The examinees click on the buttons that matches their answers. A cursor box highlights which number in the answer line is currently active. The cursor box starts on the far right end of the answer line and automatically moves to the left as the examinees enter their answers.
- To change an answer, the examinees simply click on the number in the answer line that they want to change. The cursor box will then highlight the selected number. The examinees then click on the button matching the new number they want to enter. A progress bar running across the answer line shows how much time remains to answer.
- The examinees click "Submit" when they have finished entering their answer.

After the examinee clicks "Submit" or time expires, there is a brief delay before a new Basic Math Skills item appears. During this time the examinee can concentrate on one or more of the other tasks.

Visual Monitoring Task

What Must the Examinee Do?

- Monitor a needle as it moves across a gauge from right to left.
- Earn points by stopping the needle before it reaches the end of the gauge (on the left). The examinee can click anywhere in the gauge to stop the needle.
- The number of points the examinee could earn progressively increases across the length of the gauge. The closer the needle is to the end of the gauge when the examinee stops it, the more points are earned.
- Lose points for failing to stop the needle before it reaches the end of the gauge.

How Does the Task Work?

- A needle moves across the gauge from right to left (Figure 10). The rate at which the needle moves stays the same across the length of the gauge. The needle will not speed up or slow down. However, the rate at which the needle moves could vary from item to item.

Figure 10. Visual monitoring item.

- The examineesclick on the gauge before the needle reaches the end. They can click anywhere in the gauge to stop the needle. It is not necessary to click on the needle to stop it.

After the examinees stop the needle or time expires, there will be a brief delay before a new Visual Monitoring item starts. During this time the examinees can concentrate on one or more of the other tasks.

Listening Task

What Must the Examinee Do?

- Listen for high tones.
- Earn points for correctly identifying a high tone.
- Lose points for responding to a low high tone or failing to respond to a high tone.

Figure 11. Listening task item.

How Does the Task Work?

- A tone is briefly sounded.
- The examinees click on the "High Tone" button if they hear a high tone (Figure 11). The examinees do nothing if they hear a low tone. Response speed does not affect their score, as long as they respond before the next tone begins.

There is brief delay between Listening items. During this time the examinees can concentrate on one or more of the other tasks.

Beta Testing

The MT test was beta tested on the same platform that is used to administer the TBAS. Air Force personnel were trained to administer the MT test and beta test data were collected and analyzed to ensure that the test software functioned as intended on the TBAS platform. Full-scale field testing to collect pilot data for finalizing an operational version of the MTT was beyond the scope of this contract.

Development and Field Test of a P-E Fit Measure

Instrument Development

We started with the list of work context factors shown in Table 3 and turned them into more generic work context statements. The list of statements underwent several iterations of internal review, with the goal of writing statements that were neutral in tone and understandable to persons with no RPA knowledge or experience while also accurately reflecting the RPA work context. We also wrote some "reverse"-scored items for inclusion in the instrument by trying to

write items that were non-characteristic of the RPA work context, as shown in Table 3. Our idea was that the reverse-scored items could serve as foils, preventing respondents from earning a high score simply by endorsing every statement as desirable.

We examined several response formats including:

- Likert response scale (e.g., “strongly disagree” to “strongly agree”). This type of scale is easy for respondents to understand, but is also relatively easy to fake. It also would be possible for respondents to give the same response to most items, which could lead to little information about the relative strength of their preferences. Faking would be a serious concern if this measure was administered under high stakes conditions such as operational screening.
- Ranking (e.g., rank the statements in order of preference). This response format is one way to force respondents to indicate which statements are relatively more and less preferred, and it can potentially reduce faking somewhat by preventing respondents from strongly endorsing every feature they feel they should endorse. Ranking would work well if there were only a few work context features available for comparison.
- Forced-choice response format (e.g., “pick the statement in this pair that is most true of you”). This type of scale is harder to program, administer, and score, but is one way to make it harder for respondents to fake.

We discussed response format options with the AFPC team and reached consensus that a self-report P-E fit measure would likely be administered as a self-assessment tool, rather than as an operational screening tool, because the instrument would likely be easily faked. We felt it would be best to administer it in a low stakes setting (pre-enlistment/accession) in which there would be little reason for respondents to fake. Ultimately, we used a Likert rating scale, shown below, supplemented by a ranking exercise.

A	**B**	**C**	**D**	**E**
This is something I would actively try to <u>avoid</u> in a job.	*This is something I might try to <u>avoid</u> in a job.*	*I don’t care if this is part of my job or not.*	*This is something I might <u>look for</u> in a job.*	*This is something I would actively <u>seek out</u> as part of a job.*

Our goal in using the Likert scale was to capture responses akin to *behavioral intentions* because intentions are closer to actual behavior than are opinions (Fishbein & Ajzen, 1975). Of course the longer the time between when applicants complete this measure and when they express a preference for a career field has some bearing on how proximal the responses are.

We conducted two structured reviews of the draft list of statements with RPA SMEs:

- In August 2010, the 711th Human Performance Wing, Human Effectiveness Directorate, Warfighter Readiness Research Division, Training Systems and Performance Measurement Branch (711 HPW/RHAS) in Mesa, AZ hosted focus groups with eight experienced ANG operators, and one contractor who was a former RPA pilot and trainer. We asked them to judge, for each statement, whether or not it was descriptive of the RPA work context (content validity check), and whether they thought most applicants would view the statement as a desirable, neutral, or undesirable feature of the RPA environment. We also asked them to tell us about work context factors that were missing from the list. We turned a number of their suggestions into statements that were incorporated in the draft list before the next SME review, and we reworded several other statements to reflect their input.

- In February 2011, the 432d Wing at Creech AFB, Nevada scheduled focus groups with 21 Active Duty RPA pilots (10 early career and 11 senior) and 15 RPA SOs (8 early career and 7 senior). We met separately with each of four groups– early career pilots, senior pilots, early career SOs, and senior SOs–and each group evaluated the statements in the draft P-E fit measure. We asked early career pilots and SOs to evaluate the level of desirability of each statement because we felt they would be closest to the target population in terms of their knowledge of how persons unfamiliar with the RPA environment would interpret the statements. Then we engaged in a group discussion, soliciting suggestions to make the statements more clear and suggestions for additional items. We asked senior pilots and SOs to judge whether or not each statement was descriptive (or not) of the RPA work environment, then engaged in a discussion to clarify the wording of the statements and to suggest new statements.

HumRRO incorporated reviewer comments in the measure and then asked two additional RPA SMEs to review it–one was the same contractor who had participated in focus groups in August 2010; the other was a senior ANG SO referred by one of the ANG participants. After the SME reviews, we abandoned the attempt to include reverse-scored or non-characteristic items. When they encountered these reverse items, SMEs would almost invariably say, “Well, that could be true in some units or some situations” or they felt the statement was confusing. Therefore, we dropped the few “reverse” items from the item pool. We incorporated all of the SME comments and then created a draft instrument, including instructions, which was reviewed by the AFPC team in May 2011. Their comments were incorporated in the field test version of the instrument which is shown in Appendix C. It was called the Work Interest Inventory (WII) during the field test exercise.

Field Test of the P-E Fit Measure

Purpose and Sample

The purpose of the field test was to collect initial data and reactions on the measure for use in recommending potential revisions to its content and instructions prior to a larger-scale pilot test.

The WII (P-E fit measure) was administered in paper-and-pencil format to a sample of enlisted trainees (n = 93; 52 males, 41 females; mean age = 21.3 years) completing their Basic Military Training (BMT) at Lackland AFB, TX and to a sample of officer trainees completing Officer Training School (OTS) at Maxwell AFB, AL (n = 101; 85 males, 13 females; mean age = 27.8 years).

The measure included three sections:

- Section A. Likert response. Respondents rated the extent to which, in their ideal job, they would approach or avoid each statement, using the Likert scale shown above.
- Section B. Ranking exercise. Respondents selected, in rank order, the five most preferred statements for an ideal job, and the five least preferred.
- Section C. Reactions. Respondents rated the difficulty of doing the ranking exercise and their general reactions to the instrument.

Analysis Approach

There were two steps in our analyses. First, we screened for and removed anomalous cases or data points. Second, we computed basic item and person (scale)-level statistics for use in evaluating the initial pool of items and the feasibility of the ranking exercise.

We screened for excessive missing data and flat responding (i.e., marking the same response option for all characteristics). We also screened for logical inconsistencies between the "most ideal" and "worst item" characteristics for Section B (i.e., choosing a characteristic in both sets of rankings), as well as between Section B ranking and Section A ratings (e.g., choosing a characteristic as among one's top five "most ideal" in Section B, but rating that characteristic as something one would avoid in Section A). Flagged cases were only excluded from analyses specific to the WII section in which the anomaly was observed.

Cases were filtered from analyses on the grounds of missing data based on criteria appropriate for each section (i.e., missing 20% or more Section A ratings, failing to rank five characteristics for both the "most ideal" and "worst item" lists in Section B, missing responses to all three rating-scale items in Section C). A case was filtered from analyses on the grounds of flat responding for Section A if the respondent provided the same response to all 37 items. With regard to filtering on the basis of anomalies associated with response inconsistencies, logical inconsistencies was used as grounds to further explore the data for a given case for evidence that the respondent's data might be invalid (e.g., the respondent did not understand the instructions or was not motivated). For instance, if discrepancies were found between the rankings provided in

Section B and ratings provided in Section A for a case, we closely examined the item-level data associated with that case for any further anomalies (e.g., seemingly random or oddly-patterned responding).

Overall, the number of cases excluded from analyses was limited in both samples and specific to selected sections. No cases from either sample were dropped from our analyses completely.

As discussed in greater detail below, we examined item-level descriptive statistics for each section (e.g., mean, standard deviation, minimum, and maximum). Similarly, we computed scale-level descriptive statistics across respondents for each section (e.g., e.g., mean, standard deviation, minimum, and maximum). Given the intended use of the WII as a procedure for gauging applicants' fit to the RPA work context and providing feedback to the respondents based on their responses, we examined two types of scale scores for Section A. First, we computed the average response over the 37 items for each respondent. Because all items are scaled to be characteristic of the RPA job, the average response can be viewed as a global index of the extent to which the applicant would seek out job attributes that are relevant to the RPA job. Second, we computed the number of times the respondent endorsed each of the five response options over the 37 items (the number of "A" responses, the number of "B" response, and so forth). This information can be used to provide the applicants with feedback concerning their profile normed to a larger sample of interest (e.g., RPA job incumbents). We also computed the frequency and percentage of missing or invalid responses for each section.

Field Test Results

SECTION A: RATING YOUR IDEAL JOB – LIKERT RATING EXERCISE

Enlisted Basic (BMT) Trainees. Tables 7 and 8 summarize comparisons between male and female enlisted basic trainees in their ratings of the 37 characteristics. At the item level (Table 7), only six out of the 37 items evidenced sizable and statistically significant gender differences ($d \geq .50$; $p < .05$). Specifically, male trainees rated items 4 ("responsibility for reconnaissance and surveillance"), 13 ("taking lethal action against enemy targets"), and 14 ("participating in combat operations from a remote location") significantly higher, on average, than female trainees, while females rated items 7 ("frequent observation and monitoring of your actions by others"), 10 ("working as part of a team"), and 15 ("performing many tasks simultaneously") higher, on average, than male trainees. Similarly, few sizable or statistically significant gender differences emerged at the person- or scale-level, as shown in Table 8. Both male and female trainees, for example, utilized the extreme ends of the response scale (i.e., 88% and 70.7% of male and female trainees, respectively, rated at least one characteristic an "A – This is something I would actively try to avoid in a job," and 94% and 95.1% of males and female trainees, respectively, rated at least one characteristic an "E – This is something I would actively seek out as part of a job").

Tables 9 and 10 summarize the corresponding results for the total enlisted trainee sample. Overall, the item means were in the expected direction and demonstrated sufficient variability, with standard deviations of .80 or greater (see Table 9). Similarly, none of the items exhibited

extremely low or high mean ratings. The lowest item mean, -1.09, was observed for item 32 ("Potentially limiting the amount of time you spend with family or friends"), whereas the highest item mean, 1.36, was observed for item 26 ("Opportunity to work in an emerging career field"). Basic trainees tended to utilize the minimum and maximum response options (80.2% of trainees rated at least one characteristic as "A – This is something I would actively try to avoid in a job," and 94.5% of trainees rated at least one characteristic as "E – This is something I would actively seek out as part of a job"). Similar properties and patterns were observed at the scale- level (see Table 10).

The results summarized in Table 10 can be viewed as a profile reflecting how typical or average basic trainees endorse characteristics that are descriptive of an RPA position in their ideal job. Figure 12 compares this average response profile for enlisted basic trainees (grey) to the theoretically-expected response profile of a hypothetical applicant whose work preferences are incongruent with the characteristics of the RPA job (green).[4] As illustrated in Figure 12, the basic trainees in the field test sample seem to be significantly more inclined toward an RPA job, on average, than someone whose responses would be incongruent with this career field. This figure illustrates the potential value of the WII for expanding the RPA training pipeline by better identifying applicants or recruits who would be a good match for an RPA position.

Officer (OTS) Trainees. Tables 11 and 12 summarize comparisons between male and female officer trainees in their ratings of the 37 characteristics. At the item level (Table 11), none of the items exhibited sizable or statically significant gender differences ($d \geq .50$, $p < .05$), although the latter result was generally because of low power (very few females in the sample). Three of the 37 items evidenced a standardized mean difference (or d) greater than or around .50. Female trainees rated items 1 ("making decisions that significantly impact the well-being of others") and 30 ("few opportunities to get to know your co-workers") more positively than male trainees, whereas male trainees rated item 34 ("sensing and reacting to the urgency and danger faced by individuals in harm's way") higher, on average, than female trainees. Similarly, sizable or significant gender differences at the person- or scale-level were minimal (see Table 12). Overall, male officer trainees' mean rating of all 37 characteristics (M = .39, SD = .31) was equivalent to that of female trainees (M = .38, SD = .51) (d = .03, *ns*).

Tables 13 and 14 summarize the corresponding item and scale-level results for the total officer trainee sample. As in the enlisted trainee sample, item means were generally in the expected direction and the items showed sufficient variability, with most item standard deviations being .80 or greater (see Table 13). Only a few items had item means greater than +/- 1.00. The lowest item mean, -1.20, was observed for item 32 ("potentially limiting the amount of time you spend with family or friends"), while the highest item mean, 1.61, was associated with item 17 ("opportunities to work with cutting-edge aircraft technology"). Most of the items exhibited a range of -2 to +2. None of the items had a range uniformly in the positive or negative end of the rating scale. Comparable properties and patterns emerged at the scale-level, as reported in Table 14.

[4] The hypothetical applicant profile is provided for illustration purposes only. It is simply a profile that is skewed toward the "avoid" portion of the scale for many of the items in the P-E fit measure. It is not based on actual data from applicants or SMEs.

Table 7. Section A: Rating Your Ideal Job – Item-Level Comparison between Male and Female Enlisted Basic Trainees

	Male			Female			Male-Female			
Item	*Mean*	*SD*	*n*	*Mean*	*SD*	*n*	*Diff*	*d*	*t*	*p*
1	1.02	.87	47	1.29	.87	41	-.27	-.31	-1.46	.15
2	1.27	1.01	48	1.15	.88	41	.12	.13	.62	.54
3	-.77	.95	48	-.51	.95	41	-.26	-.28	-1.28	.20
4	1.06	1.10	48	.29	.75	41	.77	**.82**	**3.79**	**.00**
5	.44	1.09	48	.49	.90	41	-.05	-.05	-.24	.81
6	.48	.83	48	.22	1.06	41	.26	.28	1.30	.20
7	-.71	.99	48	-.07	.88	41	-.64	**-.68**	**-3.18**	**.00**
8	.06	1.04	48	.34	.99	41	-.28	-.28	-1.29	.20
9	.29	.92	48	.17	1.36	41	.12	.11	.50	.62
10	.92	.90	48	1.39	.70	41	-.47	**-.59**	**-2.74**	**.01**
11	.60	1.05	48	.83	.92	41	-.23	-.23	-1.07	.29
12	.75	1.02	48	1.02	.94	41	-.27	-.28	-1.31	.19
13	.94	1.36	48	.42	1.12	41	.52	**.42**	**1.96**	**.05**
14	.92	1.33	48	.34	1.24	41	.58	**.45**	**2.10**	**.04**
15	.52	.85	48	.93	.96	41	-.41	**-.46**	**-2.12**	**.04**
16	.06	.97	47	.46	.95	41	-.40	-.42	-1.95	.05
17	1.27	.98	48	1.02	1.13	41	.25	.24	1.10	.27
18	.33	.98	48	.15	1.13	41	.19	.18	.84	.40
19	.38	1.06	48	.56	1.16	41	-.19	-.17	-.79	.43
20	.77	.83	48	.76	.99	41	.01	.02	.08	.94
21	.50	1.19	48	.54	1.21	41	-.04	-.03	-.14	.89
22	-.92	1.38	48	-.51	1.27	41	-.40	-.31	-1.43	.16
23	.23	.97	48	.42	.89	41	-.19	-.20	-.93	.35
24	.23	1.31	48	-.29	1.25	41	.52	.41	1.91	.06
25	.90	1.10	48	.93	.93	41	-.03	-.03	-.14	.89
26	1.27	.82	48	1.45	.78	40	-.18	-.23	-1.04	.30
27	.63	1.06	48	.85	1.15	40	-.23	-.21	-.95	.34
28	.23	.91	48	.30	1.02	40	-.07	-.07	-.35	.73
29	.29	.82	48	.23	.86	40	.07	.08	.37	.71
30	-.54	.92	48	-.60	1.01	40	.06	.06	.28	.78
31	-.56	.87	48	-.60	.84	40	.04	.04	.20	.84
32	-1.08	.94	48	-1.10	.81	40	.02	.02	.09	.93
33	-.42	1.11	48	-.68	1.14	40	.26	.23	1.07	.29
34	.69	.88	48	.68	1.19	40	.01	.01	.06	.95
35	.88	.73	48	1.05	.78	40	-.18	-.23	-1.08	.28
36	1.17	.81	48	1.13	.88	40	.04	.05	.23	.82
37	.50	.92	48	.48	1.30	40	.03	.02	.11	.92

Note. *Diff* = raw difference in item means, *d* = standardized mean difference or Cohen's *d*. Negative *Diff* and *d* values mean that female enlisted trainees rated an item higher, on average, than male trainees. Statistically significant *d* values ($t > 1.96$, $p < .05$) are in bold typeface.

Table 8. Section A: Rating Your Ideal Job – Scale-Level Comparison between Male and Female Enlisted Basic Trainees

	Male			Female			Male-Female			
Statistic	*Mean*	*SD*	*n*	*Mean*	*SD*	*n*	*Diff*	*d*	*t*	*p*
Count: Response A	2.67	2.01	48	2.80	2.52	40	-.13	-.06	-.28	.78
Count: Response B	5.58	3.86	48	4.90	2.85	40	.68	.20	.93	.36
Count: Response C	11.04	6.05	48	11.65	5.97	40	-.61	-.10	-.47	.64
Count: Response D	9.85	4.45	48	9.30	3.75	40	.55	.14	.62	.53
Count: Response E	7.81	6.28	48	8.35	6.80	40	-.54	-.08	-.39	.70
Percent: Response A	.07	.05	48	.08	.07	40	.00	-.06	-.27	.79
Percent: Response B	.15	.10	48	.13	.08	40	.02	.20	.94	.35
Percent: Response C	.30	.16	48	.31	.16	40	-.02	-.10	-.47	.64
Percent: Response D	.27	.12	48	.25	.10	40	.02	.14	.64	.53
Percent: Response E	.21	.17	48	.23	.18	40	-.01	-.08	-.38	.71
Overall: MEAN	.39	.43	48	.42	.44	41	-.03	-.06	-.29	.78
Overall: MDN	.50	.72	48	.66	.73	41	-.16	-.22	-1.03	.30
Overall: SD	1.10	.20	48	1.09	.22	41	.01	.05	.24	.81
Overall: MIN	-1.90	.31	48	-1.68	.52	41	-.21	**-.51**	**-2.38**	**.02**
Overall: MAX	1.94	.25	48	1.95	.22	41	-.01	-.06	-.28	.78

Note. *Diff* = raw difference in mean scale scores, *d* = standardized mean difference or Cohen's *d*. Negative *Diff* and *d* values mean that female enlisted trainees endorsed an item more frequently, on average, than male trainees. Statically significant *d* values ($t > 1.96$, $p < .05$) are in bold typeface.

Table 9. Section A: Rating Your Ideal Job – Item-Level Statistics for Total Enlisted Basic Trainee Sample (n = 91)

Item	*Mean*	*Median*	*SD*	*Min*	*Max*	*Skew*	*Kurt*	*Valid Resp*	*Missing Resp*	*% Valid*
1	1.14	1	.88	-2	2	-1.10	1.28	90	1	99
2	1.23	1	.94	-2	2	-1.45	2.15	91	0	100
3	-.65	-1	.95	-2	1	.04	-.94	91	0	100
4	.71	1	1.03	-2	2	-.28	-.77	91	0	100
5	.47	0	.99	-2	2	-.03	-.44	91	0	100
6	.36	0	.94	-2	2	-.29	.01	91	0	100
7	-.44	0	.99	-2	2	.42	.05	91	0	100
8	.19	0	1.01	-2	2	.27	.01	91	0	100
9	.22	0	1.13	-2	2	-.12	-.57	91	0	100
10	1.14	1	.84	-1	2	-.51	-.78	91	0	100
11	.73	1	.99	-2	2	-.54	-.38	91	0	100
12	.87	1	1.00	-2	2	-.74	-.14	91	0	100
13	.71	1	1.27	-2	2	-.61	-.71	91	0	100
14	.65	1	1.32	-2	2	-.57	-.81	91	0	100
15	.71	1	.92	-2	2	-.26	-.33	91	0	100
16	.22	0	.99	-2	2	.03	-.08	90	1	99
17	1.18	2	1.05	-2	2	-1.25	1.05	91	0	100
18	.26	0	1.05	-2	2	-.38	-.35	91	0	100
19	.46	0	1.10	-2	2	-.23	-.37	91	0	100
20	.76	1	.90	-2	2	-.16	-.36	91	0	100
21	.53	0	1.19	-2	2	-.35	-.62	91	0	100
22	-.75	-1	1.33	-2	2	.74	-.65	91	0	100
23	.31	0	.93	-2	2	-.14	.07	91	0	100
24	.03	0	1.32	-2	2	.00	-.99	91	0	100
25	.92	1	1.01	-1	2	-.56	-.79	91	0	100
26	1.36	2	.80	-1	2	-.87	-.42	90	1	99
27	.76	1	1.10	-2	2	-.47	-.71	90	1	99
28	.28	0	.96	-2	2	-.12	-.21	90	1	99
29	.26	0	.84	-2	2	.41	.30	90	1	99
30	-.54	-1	.98	-2	2	.63	.35	90	1	99
31	-.58	-1	.85	-2	1	-.03	-.60	90	1	99
32	-1.09	-1	.88	-2	2	.78	.45	90	1	99
33	-.53	-1	1.11	-2	2	.39	-.36	90	1	99
34	.69	1	1.02	-2	2	-.62	.03	90	1	99
35	.96	1	.76	-1	2	-.08	-.88	90	1	99
36	1.14	1	.84	-1	2	-.63	-.43	90	1	99
37	.52	1	1.11	-2	2	-.41	-.38	90	1	99

Note. *Valid Resp* = Number of valid responses, *Missing Resp* = Number of missing responses, *% Valid* = Percentage of valid responses. Items scored on a scale from -2 (“A: This is something I would actively try to avoid in a job.”) to +2 (“E: This is something I would actively seek out as part of a job.”).

Table 10. Section A: Rating Your Ideal Job – Scale-Level Descriptive Statistics for Total Enlisted Basic Trainee Sample (n = 90)

	Mean	*Median*	*SD*	*Min*	*Max*	*Skew*	*Kurt*	*Valid Resp*	*Missing Resp*	*% Valid*
Count: Response A	2.71	2.00	2.24	0	9	.68	-.17	90	0	100
Count: Response B	5.27	5.00	3.40	0	17	.77	.65	90	0	100
Count: Response C	11.31	11.00	5.93	0	28	.61	.60	90	0	100
Count: Response D	9.51	10.00	4.15	0	23	.31	.65	90	0	100
Count: Response E	8.18	6.50	6.48	0	32	1.09	1.12	90	0	100
Percent: Response A	7.3%	5.4%	6.1%	0.0%	24.3%	.68	-.18	90	0	100
Percent: Response B	14.2%	13.5%	9.2%	0.0%	45.9%	.77	.65	90	0	100
Percent: Response C	30.6%	29.7%	16.0%	0.0%	75.7%	.60	.60	90	0	100
Percent: Response D	25.7%	27.0%	11.2%	0.0%	62.2%	.30	.66	90	0	100
Percent: Response E	22.1%	17.6%	17.5%	0.0%	86.5%	1.09	1.11	90	0	100
Overall: MEAN	.41	.38	.43	-.59	1.49	.09	-.39	90	0	100

Note. *Valid Resp* = Number of valid responses, *Missing Resp* = Number of missing responses, *% Valid* = Percentage of valid responses. Overall: MEAN = Mean rating across 37 Section A items.

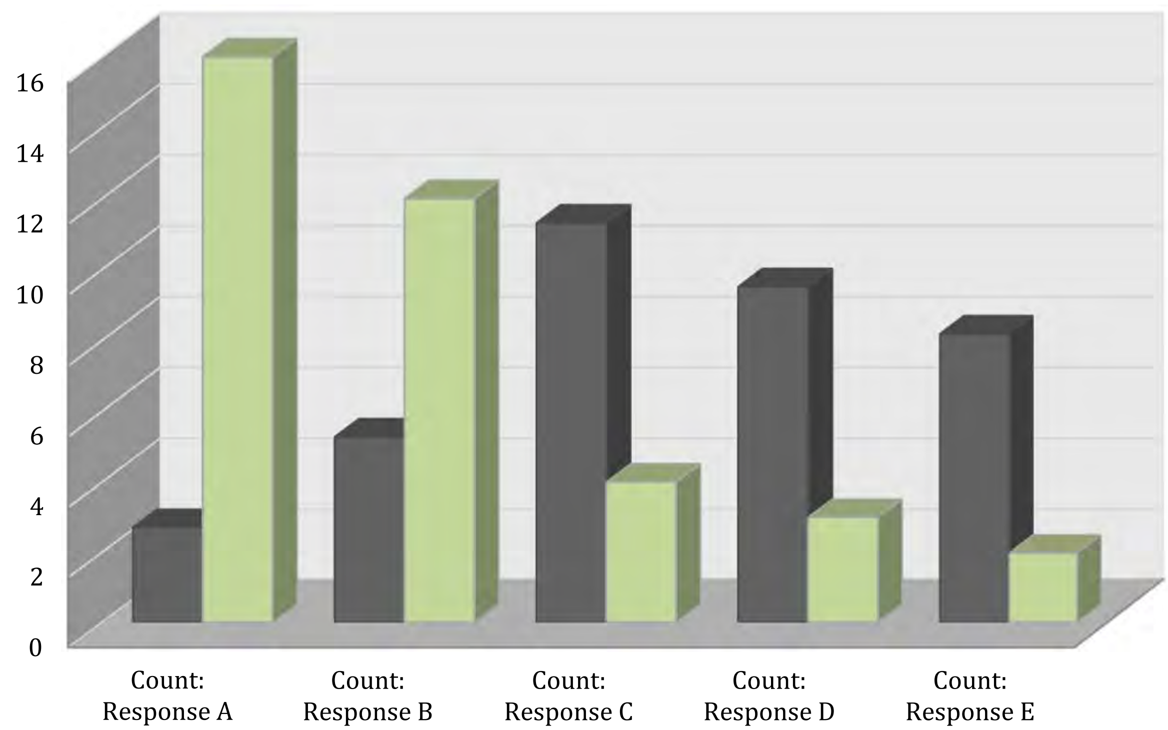

Figure 12. A comparison between the average response profile for the enlisted basic trainee sample (grey) on Section A versus the response profile for a hypothetical applicant with preferences that are incongruent with an RPA position (green).

Table 11. Section A: Rating Your Ideal Job – Item-Level Comparison between Male and Female Officer Trainees (OTS)

	Male			Female			Male-Female			
Item	*Mean*	*SD*	*n*	*Mean*	*SD*	*n*	*Diff*	*d*	*t*	*p*
1	1.14	.79	85	1.54	.78	13	-.40	-.51	-1.69	.09
2	1.15	.89	85	1.31	.95	13	-.15	-.17	-.58	.57
3	-.28	.85	85	-.31	.85	13	.03	.03	.10	.92
4	.74	.90	85	.69	.75	13	.05	.06	.19	.85
5	.02	.89	85	.08	.95	13	-.05	-.06	-.20	.84
6	.21	1.09	85	.15	1.21	13	.06	.05	.18	.86
7	-.66	.98	85	-.46	1.13	13	-.20	-.20	-.66	.51
8	.09	.93	85	.31	1.11	13	-.21	-.23	-.75	.46
9	-.13	.92	85	.08	1.44	13	-.21	-.21	-.69	.49
10	1.27	.81	85	1.31	.95	13	-.04	-.05	-.15	.88
11	.64	.99	85	.46	1.20	13	.17	.17	.57	.57
12	1.22	.70	85	1.08	.95	13	.15	.20	.67	.50
13	.71	.97	85	.62	1.26	13	.09	.09	.30	.77
14	.51	1.02	85	.69	1.11	13	-.19	-.18	-.61	.55
15	.75	.83	85	.62	1.39	13	.14	.15	.50	.62
16	.25	.84	85	.23	1.09	13	.02	.02	.06	.95
17	1.65	.70	85	1.38	.87	13	.26	.37	1.22	.23
18	.29	1.01	85	.23	.93	13	.06	.06	.21	.83
19	-.11	1.07	85	-.15	1.21	13	.05	.04	.15	.88
20	.87	.77	85	1.08	.76	13	-.21	-.27	-.90	.37
21	.40	1.28	84	.08	1.38	13	.33	.26	.85	.40
22	-.94	1.12	85	-1.00	1.29	13	.06	.05	.17	.86
23	.52	.87	85	.62	.87	13	-.10	-.11	-.38	.71
24	.24	1.05	85	-.23	1.09	13	.47	.44	1.48	.14
25	1.00	.79	85	.77	.93	13	.23	.29	.96	.34
26	1.46	.65	85	1.46	.66	13	.00	.00	-.01	.99
27	1.01	.88	85	.77	1.30	13	.24	.26	.86	.39
28	.31	.86	85	.15	1.07	13	.15	.17	.57	.57
29	-.15	.75	85	-.15	1.07	13	.00	.00	.00	1.00
30	-1.07	.77	85	-.62	1.39	13	-.46	-.53	-1.76	.08
31	-.58	.88	85	-.31	1.32	13	-.27	-.29	-.96	.34
32	-1.21	.80	85	-1.08	1.26	13	-.13	-.16	-.52	.61
33	-.32	.97	85	-.31	1.11	13	-.01	-.01	-.03	.97
34	.61	.73	85	.23	1.09	13	.38	.49	1.64	.10
35	.86	.83	85	.69	.85	13	.17	.20	.67	.51
36	1.39	.73	85	1.62	.51	13	-.23	-.33	-1.09	.28
37	.68	.95	85	.62	.87	13	.07	.07	.24	.81

Note. *Diff* = Raw difference in item means, *d* = standardized mean difference or Cohen's *d*. Negative *Diff* and *d* values mean that female officer trainees rated an item higher, on average, than male trainees. Statistically significant *d* values ($t > 1.96$, $p < .05$) are in bold typeface.

Table 12. Section A: Rating Your Ideal Job – Scale-Level Comparison between Male and Female Officer Trainees (OTS)

	Male			Female			Male-Female			
Statistic	*Mean*	*SD*	*n*	*Mean*	*SD*	*n*	*Diff*	*d*	*t*	*p*
Count: Response A	2.38	1.96	85	2.92	2.47	13	-.55	-.27	-.90	.37
Count: Response B	5.73	2.87	85	6.38	4.23	13	-.66	-.22	-.72	.48
Count: Response C	10.67	4.45	85	10.00	4.16	13	.67	.15	.51	.61
Count: Response D	11.40	4.45	85	8.92	3.23	13	2.48	.58	1.93	.06
Count: Response E	6.81	4.15	85	8.77	6.71	13	-1.96	-.43	-1.45	.15
Percent: Response A	.06	.05	85	.08	.07	13	-.01	-.27	-.90	.37
Percent: Response B	.15	.08	85	.17	.11	13	-.02	-.22	-.72	.48
Percent: Response C	.29	.12	85	.27	.11	13	.02	.15	.51	.61
Percent: Response D	.31	.12	85	.24	.09	13	.07	.58	1.93	.06
Percent: Response E	.18	.11	85	.24	.18	13	-.05	-.43	-1.44	.15
Overall: MEAN	.39	.31	85	.38	.51	13	.01	.03	.08	.93
Overall: MDN	.45	.52	85	.62	.77	13	-.17	-.30	-1.01	.32
Overall: SD	1.10	.17	85	1.13	.23	13	-.03	-.17	-.56	.58
Overall: MIN	-1.82	.38	85	-1.77	.60	13	-.05	-.13	-.44	.66
Overall: MAX	1.95	.21	85	1.92	.28	13	.03	.14	.45	.65

Note. *Diff* = Raw difference in mean scale scores, *d* = standardized mean difference or Cohen's *d*. Negative *Diff* and *d* values mean that female officer trainees endorsed an item more frequently, on average, than male trainees. Statically significant *d* values ($t > 1.96$, $p < .05$) are in bold typeface.

Figure 12 compares this average response profile for enlisted basic trainees (grey) to the theoretically-expected response profile of a hypothetical applicant whose work preferences are incongruent with the characteristics of RPA job (green).[5] As illustrated in Figure 12, the basic trainees in the field test sample seem to be significantly more inclined toward an RPA job, on average, than someone whose responses would be incongruent with this career field. This figure illustrates the potential value of the WII for expanding the RPA training pipeline by better identifying applicants or recruits who would be a good match for an RPA position.

[5] The hypothetical applicant profile is provided for illustration purposes only. It is simply a profile that is skewed toward the "avoid" portion of the scale for many of the items in the P-E fit measure. It is not based on actual data from applicants or SMEs.

Table 13. Section A: Rating Your Ideal Job – Item-Level Statistics for Total Officer Trainee Sample (n = 101)

Item	*Mean*	*Median*	*SD*	*Min*	*Max*	*Skew*	*Kurt*	*Valid Resp*	*Missing Resp*	*% Valid*
1	1.20	1	.79	-1	2	-.62	-.37	101	0	100
2	1.16	1	.91	-2	2	-1.12	1.03	101	0	100
3	-.28	0	.84	-2	2	.36	.43	101	0	100
4	.71	1	.91	-1	2	-.29	-.66	101	0	100
5	.03	0	.92	-2	2	.02	.09	101	0	100
6	.20	0	1.10	-2	2	-.17	-.76	101	0	100
7	-.64	-1	1.00	-2	2	.16	-.75	101	0	100
8	.07	0	.99	-2	2	.30	.11	101	0	100
9	-.14	0	1.01	-2	2	.17	-.59	101	0	100
10	1.30	1	.82	-1	2	-.94	.11	101	0	100
11	.61	1	1.00	-2	2	-.32	-.68	101	0	100
12	1.21	1	.73	-1	2	-.66	.27	101	0	100
13	.67	1	1.01	-2	2	-.49	-.10	101	0	100
14	.51	1	1.05	-2	2	-.31	-.51	101	0	100
15	.73	1	.90	-2	2	-.35	-.20	101	0	100
16	.24	0	.87	-2	2	-.12	-.19	101	0	100
17	1.61	2	.72	-1	2	-1.88	2.88	101	0	100
18	.27	0	1.00	-2	2	.05	-.68	101	0	100
19	-.16	0	1.10	-2	2	.09	-.64	101	0	100
20	.89	1	.76	-1	2	-.23	-.34	101	0	100
21	.36	0	1.31	-2	2	-.37	-.81	100	1	99
22	-.94	-1	1.14	-2	2	.79	-.34	101	0	100
23	.51	1	.89	-2	2	-.52	.14	101	0	100
24	.17	0	1.06	-2	2	-.04	-.64	101	0	100
25	.99	1	.81	-1	2	-.45	-.28	101	0	100
26	1.45	2	.66	0	2	-.77	-.45	101	0	100
27	.97	1	.94	-2	2	-1.04	1.02	101	0	100
28	.29	0	.88	-2	2	-.23	.23	101	0	100
29	-.15	0	.78	-2	2	-.12	.12	101	0	100
30	-1.02	-1	.87	-2	2	1.06	1.72	101	0	100
31	-.54	-1	.94	-2	2	.42	.17	101	0	100
32	-1.20	-1	.86	-2	2	.97	.87	101	0	100
33	-.30	0	.98	-2	2	-.03	-.25	101	0	100
34	.55	1	.78	-1	2	-.06	-.35	101	0	100
35	.82	1	.84	-1	2	-.27	-.52	101	0	100
36	1.43	2	.70	-2	2	-1.53	4.50	101	0	100
37	.66	1	.94	-2	2	-.60	.12	101	0	100

Note. *Valid Resp* = Number of valid responses, *Missing Resp* = Number of missing responses, *% Valid* = Percentage of valid responses. Items rated on a scale from -2 ("A: This is something I would actively try to avoid in a job.") to +2 ("E: This is something I would actively seek out as part of a job.").

Table 14. Section A: Rating Your Ideal Job – Scale-Level Descriptive Statistics for Total Officer Trainee (OTS) Sample (n = 101)

	Mean	*Median*	*SD*	*Min*	*Max*	*Skew*	*Kurt*	*Valid Resp*	*Missing Resp*	*% Valid*
Count: Response A	2.51	2.00	2.19	0	11	1.27	2.12	101	0	100
Count: Response B	5.85	5.00	3.03	0	16	.77	.84	101	0	100
Count: Response C	10.52	10.00	4.37	1	22	.05	-.54	101	0	100
Count: Response D	11.07	11.00	4.45	2	22	.26	-.32	101	0	100
Count: Response E	7.03	6.00	4.54	0	22	.80	.66	101	0	100
Percent: Response A	6.8%	5.4%	5.9%	0.0%	29.7%	1.27	2.11	101	0	100
Percent: Response B	15.8%	13.5%	8.2%	0.0%	43.2%	.77	.84	101	0	100
Percent: Response C	28.5%	27.0%	11.8%	2.7%	59.5%	.06	-.54	101	0	100
Percent: Response D	29.9%	29.7%	12.0%	5.4%	59.5%	.26	-.32	101	0	100
Percent: Response E	19.0%	16.2%	12.3%	0.0%	59.5%	.80	.65	101	0	100
Overall: MEAN	.39	.41	.35	-.41	1.46	.28	.74	101	0	100

Note. *Valid Resp* = Number of valid responses, *Missing Resp* = Number of missing responses, *% Valid* = Percentage of valid responses. Overall: MEAN = Mean rating across 37 Section A items.

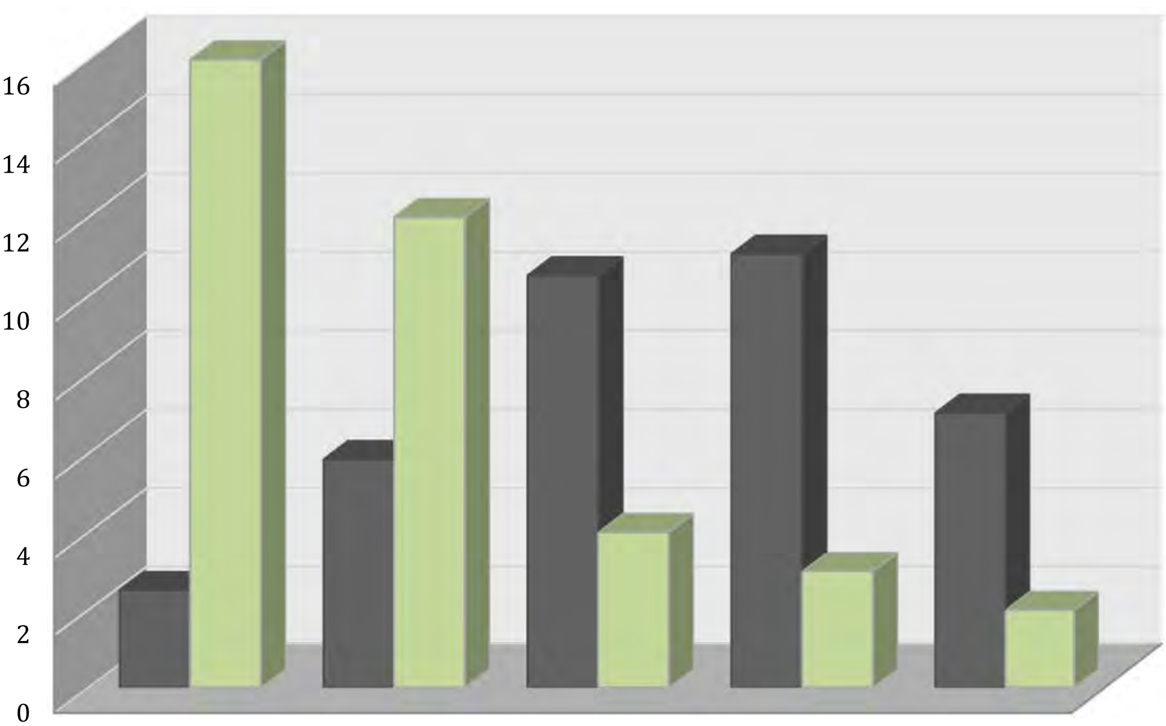

Figure 13. A comparison between the average response profile for the OTS sample (grey) on Section A versus the response profile for a hypothetical applicant with preferences that are incongruent with an RPA position (green).

SECTION B: DESCRIBING YOUR IDEAL AND WORST JOBS – RANKING EXERCISE

Enlisted Basic (BMT) Trainees. Table 15 summarizes the characteristics most frequently ranked by enlisted basic trainees in their top five for describing their "Most Ideal Job" and their "Worst Job" by gender. As reported in Table 15, three of the top five most frequently cited characteristics for describing one's "Most Ideal Job" were the same for males and females: (a) opportunities to protect or rescue friendly forces from harm (item 2); (b) opportunities to work with cutting-edge aircraft technology" (item 17); and (c) opportunity to work in an emerging career field (item 26). Consistent with the ratings from Section A, however, male trainees were more likely to rank combat-related characteristics in their top five (e.g., taking lethal action against enemy targets, item 13), whereas females were more likely to cite social aspects in their top five (e.g., working as part of a team, item 10). Results were similar for the top five characteristics describing one's "Worst Job", with four of the top five most frequently ranked characteristics being the same for males and females: (a) providing negative performance feedback to co-workers (item 3); (b) spending most of the work shift in a windowless room, viewing multiple computer monitors (item 22); (c) few opportunities to get to know your co-workers (item 30); and (d) potentially limiting the amount of time you spend with family or friends (item 32). Male trainees more frequently ranked "frequent observation and monitoring of your actions by others" (item 7) among the top five for describing their "Worst Job", while female trainees cited "performing actions that could seriously injure or kill others (non-friendly and friendly)" (item 24).

Officer (OTS) Trainees. Table 16 summarizes the characteristics most frequently ranked by officer trainees in their top five for describing their "Most Ideal Job" and their "Worst Job" by gender. Similar to the enlisted trainee sample, male and female officer trainees ranked the same three characteristics among their top five for describing their "Most Ideal Job": (a) opportunities to protect or rescue friendly forces from harm (item 10); (b) opportunity to work in an emerging career field (item 26); and (c) ability to see how your work contributes to the broader mission (item 36). The two groups differed in that females were more likely to endorse characteristics related to helping others (e.g., opportunities to protect or rescue friendly forces from harm, item 2). Male and female officer trainees similarly ranked the same four characteristics among their top five for describing their "Worst Job": (a) frequent observation and monitoring of your actions by others (item 7); (b) spending most of the work shift in a windowless room, viewing multiple computer monitors (item 22); (c) few opportunities to get to know your co-workers (item 30); and (d) potentially limiting the amount of time you spend with family or friends (item 32). The two groups differed in that male trainees included "limited interactions with co-workers outside of work" (item 31) among their top five, while female trainees were more likely to rank "remaining alert and highly focused for long periods of time" (item 9) in their top five for describing their "Worst Job."

Comparing Enlisted and Officer Trainees. Table 17 compares the enlisted basic and officer trainees on the characteristics most frequently ranked in their top five for describing their "Most Ideal Job" and their "Worst Job". Overall, enlisted basic and officer trainees were

generally consistent in the characteristics most frequently ranked in their respective top five choices. When describing their “Most Ideal Job,” enlisted basic and officer trainees had four characteristics in common among their top five: (a) opportunities to protect friendly forces (item 2); (b) working as part of a team (item 10); (c) opportunities to work with cutting-edge aircraft technology (item 17); and (d) opportunity to work in an emerging career field (item 26). The two groups differed in that enlisted basic trainees cited, “taking lethal action against enemy targets” (item 13), among their top five for describing their “Most Ideal Job,” whereas officer trainees included, “ability to see how your work contributes to the broader mission” (item 36) in their top five. Enlisted basic and officer trainees similarly had four characteristics in common among the top five for describing their “Worst Job”: (a) frequent observation and monitoring of your actions by others (item 7); (b) spending most of the work shift in a windowless room, viewing multiple computer monitors (item 22); (c) few opportunities to get to know your co-workers (item 30); and (d) potentially limiting the amount of time you spend with family or friends (item 32). The two groups differed in that enlisted basic trainees ranked, “providing negative performance feedback to co-workers” (item 3), among their top five, while officer trainees cited, “remaining alert and highly focused for long periods of time” (item 9) for describing their “Worst Job.” Both enlisted basic and officer trainees ranked “potentially limiting the amount of time with family or friends” (item 32) and “spending most of the work shift in a windowless room, viewing multiple computer monitors” (item 22) as the two characteristics most descriptive of their “Worst Job.” Over 50% of the participants in each group ranked these two characteristics in their top five for “Worst Job.”

Table 15. Section B: Describing Your Ideal and Worst Jobs – Most Frequently Endorsed "Most Ideal Job" and "Worst Job" Characteristics by Gender for the Enlisted Basic Trainee Sample

			Frequency						*Percent of Total*				
	Item	Characteristic	1	2	3	4	5	Total	1	2	3	4	5
"MOST IDEAL JOB" CHARACTERISTICS	*Males*												
	17	Opportunities to work with cutting edge aircraft technology.	7	5	6	4	3	25	28.0	20.0	24.0	16.0	12.0
	13	Taking lethal action against enemy targets when authorized to do so.	9	3	6	2	3	23	39.1	13.0	26.1	8.7	13.0
	2	Opportunities to protect or rescue friendly forces from harm.	10	3	4	2	1	20	50.0	15.0	20.0	10.0	5.0
	14	Participating in combat operations from a remote location.	2	4	4	4	5	19	10.5	21.1	21.1	21.1	26.3
	26	Opportunity to work in an emerging career field.	2	6	5	2	4	19	10.5	31.6	26.3	10.5	21.1
	Females												
	10	Working as part of a team (instead of alone) to get tasks completed.	9	3	6	3	2	23	39.1	13.0	26.1	13.0	8.7
	2	Opportunities to protect or rescue friendly forces from harm.	3	2	6	4	3	18	16.7	11.1	33.3	22.2	16.7
	26	Opportunity to work in an emerging career field.	4	8	0	4	1	17	23.5	47.1	0.0	23.5	5.9
	17	Opportunities to work with cutting edge aircraft technology.	3	2	3	2	4	14	21.4	14.3	21.4	14.3	28.6
	1	Making decisions that significantly impact the well-being of others.	7	4	1	1	0	13	53.8	30.8	7.7	7.7	0.0
"WORST JOB" CHARACTERISTICS	*Males*												
	32	Potentially limiting the amount of time you spend with family or friends.	19	4	1	4	2	30	63.3	13.3	3.3	13.3	6.7
	22	Spending most of the work shift in a windowless room, viewing multiple computer monitors.	15	6	3	2	3	29	51.7	20.7	10.3	6.9	10.3
	3	Providing negative performance feedback to co-workers.	3	3	9	5	5	25	12.0	12.0	36.0	20.0	20.0
	7	Frequent observation and monitoring of your actions by others.	3	5	3	6	2	19	15.8	26.3	15.8	31.6	10.5
	30	Few opportunities to get to know your co-workers.	1	5	4	5	3	18	5.6	27.8	22.2	27.8	16.7
	Females												
	32	Potentially limiting the amount of time you spend with family or friends.	11	5	5	3	1	25	44.0	20.0	20.0	12.0	4.0
	22	Spending most of the work shift in a windowless room, viewing multiple computer monitors.	7	7	2	1	3	20	35.0	35.0	10.0	5.0	15.0
	24	Performing actions that could seriously injure or kill others (non-friendly and friendly).	4	3	3	6	3	19	21.1	15.8	15.8	31.6	15.8
	30	Few opportunities to get to know your co-workers.	5	4	1	4	4	18	27.8	22.2	5.6	22.2	22.2
	3	Providing negative performance feedback to co-workers.	4	2	2	3	3	14	28.6	14.3	14.3	21.4	21.4

Table 16. Section B: Describing Your Ideal and Worst Jobs – Most Frequently Endorsed "Most Ideal Job" and "Worst Job" Characteristics by Gender for the Officer Trainee Sample

	Item	Characteristic	Frequency 1	2	3	4	5	Total	Percent of Total 1	2	3	4	5
"MOST IDEAL JOB" CHARACTERISTICS	*Males*												
	17	Opportunities to work with cutting edge aircraft technology.	23	13	9	7	5	57	40.4	22.8	15.8	12.3	8.8
	26	Opportunity to work in an emerging career field.	5	11	10	11	6	43	11.6	25.6	23.3	25.6	14.0
	10	Working as part of a team (instead of alone) to get tasks completed.	9	12	7	3	5	36	25.0	33.3	19.4	8.3	13.9
	36	Ability to see how your work contributes to the broader mission, even if its importance is not always clear and direct.	5	7	7	5	8	32	15.6	21.9	21.9	15.6	25.0
	12	Handling mentally challenging situations and issues.	8	5	3	7	4	27	29.6	18.5	11.1	25.9	14.8
	Females												
	36	Ability to see how your work contributes to the broader mission, even if its importance is not always clear and direct.	1	4	0	2	1	8	12.5	50.0	0.0	25.0	12.5
	10	Working as part of a team (instead of alone) to get tasks completed.	3	1	1	1	1	7	42.9	14.3	14.3	14.3	14.3
	1	Making decisions that significantly impact the well-being of others.	2	1	1	0	2	6	33.3	16.7	16.7	0.0	33.3
	2	Opportunities to protect or rescue friendly forces from harm.	2	2	0	1	1	6	33.3	33.3	0.0	16.7	16.7
	26	Opportunity to work in an emerging career field.	1	1	2	1	0	5	20.0	20.0	40.0	20.0	0.0
"WORST JOB" CHARACTERISTICS	*Males*												
	32	Potentially limiting the amount of time you spend with family or friends.	24	7	7	7	6	51	47.1	13.7	13.7	13.7	11.8
	22	Spending most of the work shift in a windowless room, viewing multiple computer monitors.	19	7	5	6	4	41	46.3	17.1	12.2	14.6	9.8
	30	Few opportunities to get to know your co-workers.	2	10	12	11	2	37	5.4	27.0	32.4	29.7	5.4
	7	Frequent observation and monitoring of your actions by others.	6	11	4	5	2	28	21.4	39.3	14.3	17.9	7.1
	31	Limited interactions with co-workers outside of work.	2	5	4	4	8	23	8.7	21.7	17.4	17.4	34.8
	Females												
	22	Spending most of the work shift in a windowless room, viewing multiple computer monitors.	0	1	5	1	1	8	0.0	12.5	62.5	12.5	12.5
	32	Potentially limiting the amount of time you spend with family or friends.	6	0	1	1	0	8	75.0	0.0	12.5	12.5	0.0
	30	Few opportunities to get to know your co-workers.	0	2	0	2	2	6	0.0	33.3	0.0	33.3	33.3
	7	Frequent observation and monitoring of your actions by others.	0	3	0	1	0	4	0.0	75.0	0.0	25.0	0.0
	9	Remaining alert and highly-focused for long periods of time, even when little is happening.	1	1	2	0	0	4	25.0	25.0	50.0	0.0	0.0

Table 17. Section B: Describing Your Ideal and Worst Jobs – Comparison of the Most Frequently Endorsed "Most Ideal Job" and "Worst Job" Characteristics between the Total Enlisted Basic Trainee and Officer Trainee Samples

			Frequency						*Percent of Total*				
	Item	Characteristic	1	2	3	4	5	Total	1	2	3	4	5
"MOST IDEAL JOB" CHARACTERISTICS		*Enlisted Basic Trainees*											
	10	Working as part of a team (instead of alone) to get tasks completed.	10	11	8	6	4	39	25.6	28.2	20.5	15.4	10.3
	17	Opportunities to work with cutting edge aircraft technology.	10	7	9	6	7	39	25.6	17.9	23.1	15.4	17.9
	2	Opportunities to protect or rescue friendly forces from harm.	13	5	10	6	4	38	34.2	13.2	26.3	15.8	10.5
	26	Opportunity to work in an emerging career field.	6	14	5	6	5	36	16.7	38.9	13.9	16.7	13.9
	13	Taking lethal action against enemy targets when authorized to do so.	9	5	6	4	3	27	33.3	18.5	22.2	14.8	11.1
		Officer Trainees											
	17	Opportunities to work with cutting edge aircraft technology.	25	14	10	7	5	61	41.0	23.0	16.4	11.5	8.2
	26	Opportunity to work in an emerging career field.	7	12	12	12	6	49	14.3	24.5	24.5	24.5	12.2
	10	Working as part of a team (instead of alone) to get tasks completed.	12	14	9	4	6	45	26.7	31.1	20.0	8.9	13.3
	36	Ability to see how your work contributes to the broader mission, even if its importance is not always clear and direct.	6	11	8	7	9	41	14.6	26.8	19.5	17.1	22.0
	2	Opportunities to protect or rescue friendly forces from harm.	11	7	7	2	7	34	32.4	20.6	20.6	5.9	20.6
"WORST JOB" CHARACTERISTICS		*Enlisted Basic Trainees*											
	32	Potentially limiting the amount of time you spend with family or friends.	30	9	6	7	3	55	54.5	16.4	10.9	12.7	5.5
	22	Spending most of the work shift in a windowless room, viewing multiple computer monitors.	22	13	5	3	6	49	44.9	26.5	10.2	6.1	12.2
	3	Providing negative performance feedback to co-workers.	7	5	11	8	8	39	17.9	12.8	28.2	20.5	20.5
	30	Few opportunities to get to know your co-workers.	6	9	5	9	7	36	16.7	25.0	13.9	25.0	19.4
	7	Frequent observation and monitoring of your actions by others.	3	6	5	9	5	28	10.7	21.4	17.9	32.1	17.9
		Officer Trainees											
	32	Potentially limiting the amount of time you spend with family or friends.	31	8	8	8	6	61	50.8	13.1	13.1	13.1	9.8
	22	Spending most of the work shift in a windowless room, viewing multiple computer monitors.	20	8	10	8	5	51	39.2	15.7	19.6	15.7	9.8
	30	Few opportunities to get to know your co-workers.	2	12	12	13	5	44	4.5	27.3	27.3	29.5	11.4
	7	Frequent observation and monitoring of your actions by others.	6	14	5	6	2	33	18.2	42.4	15.2	18.2	6.1
	9	Remaining alert and highly-focused for long periods of time, even when little is happening.	3	4	8	6	4	25	12.0	16.0	32.0	24.0	16.0

SECTION C: YOUR REACTIONS TO THE INVENTORY

The top half of Table 18 summarizes enlisted trainees' reactions to the inventory by gender. Overall, male enlisted trainees (M = 4.32, SD = .59) reacted significantly more positively to the inventory, on average, than female enlisted trainees (M = 3.99, SD = .59) (d = .56, p < .05). Specifically, male trainees rated the ease of the ranking exercise and the clarity of the instructions significantly higher than did female trainees (d = .49, p < .05; d = .53, p <.05.

The bottom-half of Table 18 summarizes officer trainees' reactions to the inventory by gender. Overall, female officer trainees (M = 4.28, SD = .40) rated the inventory significantly more positively than male officer trainees (M = 3.92, SD = .55) (d = -.68, p < .05). In particular, female officer trainees rated the ease of the ranking exercise significantly higher than male trainees (d = -.91, p < .05).

Table 18. Section C: Your Reactions to the Inventory – Comparison between Male and Female Trainees by Sample

	Male			Female			Male-Female			
Sample/Item	*Mean*	*SD*	*n*	*Mean*	*SD*	*n*	*Diff*	*d*	*t*	*p*
Enlisted Basic Trainees (n = 89)										
1. Ease of Ranking Exercise (Section B)	4.15	.95	48	3.68	.99	41	.46	**.49**	**2.26**	**.03**
3a. Instructions Clarity	4.48	.65	48	4.12	.71	41	.36	**.53**	**2.47**	**.02**
3b. Item Clarity	4.33	.75	48	4.17	.67	41	.16	.23	1.07	.29
Overall	4.32	.59	48	3.99	.59	41	.33	**.56**	**2.62**	**.01**
Officer Trainees (n = 96)										
1. Ease of Ranking Exercise (Section B)	3.69	.90	83	4.46	.52	13	-.77	**-.91**	**-3.03**	**.00**
3a. Instructions Clarity	4.10	.64	83	4.23	.73	13	-.13	-.21	-.69	.49
3b. Item Clarity	3.99	.76	83	4.15	.55	13	-.17	-.23	-.76	.45
Overall	3.92	.55	83	4.28	.40	13	-.36	**-.68**	**-2.24**	**.03**

Note. All questions rated on a 5-point scale, with anchors for question 1 ranging from "Very Difficult" to "Very Easy" and
anchors for questions 3a and 3b ranging from "Very Bad" to "Very Good." *Diff* = raw difference in mean scores, *d* = standardized mean difference or Cohen's *d*. Negative *Diff* and *d* values mean that female enlisted basic trainees endorsed an item more frequently, on average, than male trainees. Statically significant *d* values (t > 1.96, p < .05) are in bold typeface.

Table 19 summarizes reactions to the inventory for both the enlisted and officer trainee samples. Both samples generally reacted positively to the inventory. The mean score for both groups was near the scale anchor "good." Overall, enlisted trainees tended to react more positively to the inventory than officer trainees. However, the differences between the two samples were not statistically significant (p >.05) or were generally small in magnitude: ease of ranking exercise (d = .11), clarity of instructions (d = .34), clarity of items (d = .33), and overall (d = .33). The majority of both samples provided a mean rating, across reaction questions, of 4.0 or higher (70% of enlisted trainees and 60% of officer trainees) and none provided a mean rating

lower than 2.0. Both samples reacted more positively to the clarity of the instructions and to the items than to the ranking exercise.

Table 19. Section C: Your Reactions to the Inventory – Comparison between Total Enlisted Basic and Officer Trainee Samples in Item- and Scale-Level Descriptive Statistics

Sample/Item	*Mean*	*Median*	*SD*	*Min*	*Max*	*Skew*	*Kurt*	*Valid Resp*	*Missing Resp*	*% Valid*
Enlisted Basic Trainees										
1. Ease of Ranking Exercise (Section B)	3.91	4	1.00	1	5	-.57	-.43	90	0	100
3a. Instructions Clarity	4.32	4	.70	3	5	-.54	-.82	90	0	100
3b. Item Clarity	4.26	4	.71	3	5	-.42	-.94	90	0	100
Overall	4.16	4	.61	2.67	5.00	-.21	-.70	90	0	100
Officer Trainees										
1. Ease of Ranking Exercise (Section B)	3.81	4	.90	1	5	-.47	-.04	99	2	98
3a. Instructions Clarity	4.09	4	.66	3	5	-.10	-.64	99	2	98
3b. Item Clarity	4.02	4	.73	2	5	-.52	.36	99	2	98
Overall	3.97	4	.54	2.67	5.00	-.20	-.83	99	2	98

Note. All questions rated on a 5-point scale, with anchors for question 1 ranging from very difficult to very easy and anchors for questions 3a and 3b ranging from very bad to very good. *Valid Resp* = Number of valid responses, *Missing Resp* = Number of missing responses, *% Valid* = Percentage of valid responses. Items rated on a scale from 1 (“Very Difficult” for item 1, “Very Bad” for items 3a and 3b) to 5 (“Very Easy” for item 1, “Very Good” for items 3a and 3b).

Project Summary

We began by integrating information about the SAOCs required in the RPA pilot and SO jobs. We used the O*NET content model as an organizing structure to ensure that we covered all of the important domains (e.g., abilities, skills, work style preferences, work context) and to provide a well-researched taxonomic structure and labels for the disparate sources of information. RPA SMEs and the AFPC project team helped us narrow the list to those SAOCs that would be most critical to measure in an entry-level selection process. Next, we worked with the AFPC team to take account of practical considerations, such as realistic constraints on testing time and how the predictor measures could fit into existing enlisted and officer selection processes. Ultimately, we provided two options for recommended entry-level selection batteries. One option makes maximal use of existing operational selection tools and administration processes; the second replaces some of the existing selection tools with others that have demonstrated evidence of reliability and validity, as well as at least some evidence that they result in smaller gender subgroup score differences (and possibly smaller race/ethnic subgroup score differences).

We were also, within the scope of this project, to develop two new predictor measures to address important measurement gaps without adding substantially to the testing burden for enlisted or officer candidates. The first is a measure of time sharing ability that involves performing multiple tasks tapping working memory, task prioritization, and selective attention. This measure can be administered on the existing TBAS platform and it has a modular programming foundation that provides a great deal of flexibility for future research and adaptations. This measure could be used for selection into any career field that requires time sharing ability, and ican also be used for basic research on time sharing abilities. The second new measure is an RPA-specific P-E fit measure. This instrument is best suited for use as a self-assessment tool that can help potential recruits determine if the RPA work context would be a good fit for their work preferences. It could open a door for recruiters to discuss the RPA career field prior to enlistment or accessioning.

We believe that adding the MT Test to the selection process will provide incremental validity beyond existing measures, but this is, of course, an empirical question. We also believe that the P-E fit measure can assist with recruiting candidates into the RPA career field.

In the future, the USAF could consider supplementing the recommended predictor batteries with part or all of the Predator selection battery being developed by the UK RAF. The USAF could also consider developing measures to address other measurement gaps identified in this project, including judgment and decision making, critical thinking skills, teamwork skills, and/or oral expression and comprehension skills. Prior to developing such measures, we recommend further discussion and exploration of the likely increment in validity beyond existing measures, relative to the likely cost of increasing test administration time and/or adding a requirement for non-standard equipment (e.g., the capability to capture audio input).

References

Ackerman, P. L. (1988). Determinants of individual differences during skill acquisition: Cognitive abilities and information processing. *Journal of Experimental Psychology: General, 117*, 288-318.

Ackerman, P. L. (1992). Predicting individual differences in complex skill acquisition: Dynamics of ability determinants. *Journal of Applied Psychology*, *77*, 598-614.

Ackerman, P. L. (2004). *New approaches to assessment and evaluation of perceptual speed abilities* (AFRL-SR-AR-TR-04-0076). Arlington, VA: U.S. Air Force Research Laboratory, Office of Scientific Research.

Ackerman, P. L. (2007). New developments in understanding skilled performance. *Current Directions in Psychological Science, 16,* 235-239.

Ackerman, P. L., & Beier, M. E. (2007). Further explorations of perceptual speed abilities in the context of assessment methods, cognitive abilities, and individual differences during skill acquisition. *Journal of Experimental Psychology: Applied, 13,* 249-272.

Ackerman, P. L., Beier, M. E., & Boyle, M. O. (2002). Individual differences in working memory within a nomological network of cognitive and perceptual speed abilities. *Journal of Experimental Psychology: Applied*, *131*, 567-580. DOI: 10.1037//0096-3445.131.4.567

Ackerman, P. L., & Cianciolo, A. T. (2000). Cognitive, perceptual-speed, and psychomotor determinants of individual differences during skill acquisition. *Journal of Experimental Psychology: Applied*, 6, 259-290. DOI: 10.1037//1076-989X.6.5.259

Aero Innovation Inc. (1998, June). *WOMBAT-CS Candidate"s Manual (21st edition) (for software version CS 4.9)*. Montreal, Quebec: Author.

Aero Innovation Inc. (1999). *Wombat-FC (Version 1.3) candidate manual*. Author.

Agee, R. C., Shore, W. C., Alley, W. E., Barto, E., & Halper, M. (2009). *Air Force Officer Selection Technical Requirements Survey (AFOSTRS) Volume 1: Analysis of quantitative results.* Randolph AFB: Air Force Personnel Center, Strategic Research and Assessment Branch (AFPC/DSYX).

Alderton, D. L., Wolfe, J. H., & Larson, G. E. (1997). The ECAT Battery. *Military Psychology, 9,* 5–37.

Alley, W. E. (2000). JOIN *item content and syntax templates* (FR-00-05). Millington, TN: Navy Personnel Research, Studies, and Technology Division Bureau of Naval Personnel (NPRST/PERS-1).

Alley, W. E., & Matthews, M. D. (1982). The Vocational Interest Career Examination: A description of the instrument and possible applications. *The Journal of Psychology, 112,* 169-193.

Bailey, M. (2008). *Predator Pilot and Sensor Operator selection test batteries* (RAFC Cranwell Psychologist Report 00/08). Royal Air Force College, Cranwell, England.

Barnes, M. J., Knapp, B. G., Tillman, B. W., Walters, B. A. & Velicki, D. (2000). *Crew systems analysis of unmanned aerial vehicle (UAV) future job and tasking environments* (ARL- TR-2081). Aberdeen Proving Ground, MD: Army Research Laboratory.

Bedney, G., & Meister, D. (1999). Theory of activity and situational awareness. *International Journal of Cognitive Ergonomics, 3,* 63-72.

Bell, H., & Lyon, D. (2000). Using observer ratings to assess situation awareness. In M.R. Endsley & D.J. Garland (Eds.), *Situation awareness analysis and measurement* (pp 129-146). Routledge Publishing.

Biggerstaff, S., Blower, D. J., Portman, C. A., & Chapman, A. D. (1998). *The development and initial validation of the unmanned aerial vehicle (UAV) external pilot selection system* (NAMRL-1398). Pensacola, FL: Naval Aerospace Medical Research Laboratory.

Blower, D. J. (1998). *Psychometric equivalency issues for the APEX system* (NAMRL Special Report 98-1). Pensacola, FL: Naval Aerospace Medical Research Laboratory.

Borman, W. C., Schneider, R. J., & Houston, J. S. (2009). *The Navy Computerized Adaptive Personality Scales: Evidence for validity.* Paper presented at the annual conference of the International Military Testing Association, Los Angeles, CA. Retrieved from http://www.imta.info/PastConferences/Presentations.aspx.

Bowlin, S. (2010, January 26). *First group of BMT graduates begin sensor operator technical school.* Retrieved August 28, 2010, from U.S. Air Force Web site: http://www.af.mil/news/story.asp?id=123187204

Bradley, K. M., Brown, D. G., & Sellman, W. S. (2007). *ECAT validity analysis: A replication study*. (FR-07-37). Alexandria, VA: Human Resources Research Organization.

Branscome, T. A., & Grynovicki, J. O. (2007). *An investigation of factors affecting multi-task performance in an immersive environment* (ARL-TR-4325). Aberdeen Proving Ground, MD: U.S. Army Research Laboratory.

Brookfield, S. D. (1987) *Developing critical thinkers: Challenging adults to explore alternative ways of thinking and acting*. San Francisco, CA: Jossey-Bass Publishers.

Bruskiewicz, K. T., Houston, J. S., Hezlett, S. A., & Ferstl, K. L. (2007). *Development of a selection instrument for unmanned aerial system (UAS) operations* (TR 50). Minneapolis, MN: Personnel Decisions Research Institutes, Inc.

Burke, E., Hobson, C., Linsky, C. (1997). Large sample validations of three general predictors of pilot training success. *The International Journal of Aviation Psychology, 7*, 225-234.

Campbell, J. P. & Knapp, D. K. (2001). *Exploring the limits in personnel selection and classification.* Mahwah, NJ: Lawrence Erlbaum Associates, Publishers.

Carretta, T. R. (1987). *Basic attributes tests (BAT) system: Development of an automated test battery for pilot selection* (AFHRL-TR-87-9). Brooks AFB, TX: Air Force Human Resources Laboratory.

Carretta, T. R. (2005). *Development and validation of the Test of Basic Aviation Skills (TBAS)* ,AFRL-HE-WP-TR-2005-0172. Wright-Patterson AFB, OH: Air Force Materiel Command, Air Force Research Laboratory, Human Effectiveness Directorate, Warfighter Interface Division.

Carretta, T. R. (2008). *Predictive validity of the Air Force Officer Qualifying Test for USAF air battle manager training performance,* AFRL-RH-WP-TR-2009-0007. Wright-Patterson AFB, OH: Air Force Research Laboratory, Human Effectiveness Directorate, Supervisory Control Interfaces Branch.

Carretta, T. R. (2009). *Predictive validity of the Air Force Officer Qualifying Test for Non-Rated Officer Specialties.* AFRL-RH-WP-TR-2009-XXXX. Wright-Patterson AFB, OH: Air Force Research Laboratory, Human Effectiveness Directorate, Supervisory Control Interfaces Branch.

Carretta, T. R., & King, R. E. (2008). *USAF enlisted Air Traffic Controller selection: Examination of the predictive validity of the FAA Air Traffic Selection and Training Battery versus Training Performance* (DOT/FAA/AM-08/9). Washington, DC: Office of Aerospace Medicine.

Carretta, T. R., Perry, Jr., D. C., & Ree, M. J. (1996). Prediction of situational awareness in F-15 pilots. The *International Journal of Aviation Psychology, 6*, 21-41.

Carretta, T. R., & Ree, M. J. (2003). Pilot selection methods. In B. H. Kantowitz (Series Ed.) & P. S. Tsang & M. A. Vidulich (Vol. Eds.). *Human factors in transportation: Principles and practices of aviation psychology* (pp. 357-396). Mahwah, NJ: Erlbaum.

Carroll, J. B. (1993). *Human cognitive abilities: A survey of factor-analytic studies.* New York, NY: Cambridge University Press.

Chappelle, W., McDonald, K., & King, R. E. (2010). *Psychological attributes critical to the performance of MQ-1 and MQ-9 Reaper U.S. Air Force Sensor Operators* (AFRL-SA-BR-TR-2010-0007). Brooks City-Base, TX: Air Force Research Laboratory, 711th Human Performance Wing, School of Aerospace Medicine. Retrieved September 22, 2011 from http://airforcemedicine.afms.mil/idc/groups/public/documents/afms/ctb_140465.pdf

Chappelle, W., McDonald, K., & McMillan, K. (2011). *Important and critical psychological attributes of USAF MQ-1 Predator and MQ-9 Reaper Pilots according to subject matter experts* (AFRL-SA-WP-TR-2011-0002). Wright-Patterson AFB, OH: Air Force Research Laboratory, 711th Human Performance Wing, School of Aerospace Medicine. Retrieved September 22, 2011 from http://www.dtic.mil/cgi-

bin/GetTRDoc?Location=U2&doc=GetTRDoc.pdf&AD=ADA525910

Chen, H. T., & Jones, L. A. (2008). *Predictive validity and reliability of the Navy Vocational Interest Inventory: Job Opportunities in the Navy (JOIN)*. Millington, TN: Navy Personnel Research, Studies, and Technology Division Bureau of Naval Personnel (NPRST/PERS-1).

Christal, R., Barucky, J. M., Driskill, W. E, & Collis, J. M. (1997). *The Air Force Self Description Inventory (AFSDI): A summary of continuing research* (Informal Technical Final Report F33615-91-D-0010). San Antonio, TX: Metrica, Inc.

Church, A. (2011, June). RPA ramp up. *Air Force Magazine, 94* (6). Retrieved July 15, 2011 from http://www.airforcemagazine.com/MagazineArchive/Pages/2011/ June%202011/0611RPA.aspx

Damos, D. L. (2007). *Aircrew screening instruments review.* Unpublished manuscript prepared for the Air Force Personnel Center, Strategic Research & Analysis Branch.

Drasgow, F., Embretson, S.E., Kyllonen, P.C., & Schmitt, N. (2006). *Technical review of the Armed Services Vocational Aptitude Battery (ASVAB)* (FR-06-25). Alexandria, VA: Human Resources Research Organization.

Driskill, W. E., Koonce, J. M., Nance, P., & Weissmuller, J. J. (2001). *Skills, knowledge and abilities underlying success in USAF pilot training* (AFRL-HE-AZ-TR-2000-0005). Mesa, AZ: Air Force Research Laboratory, Human Effectiveness Directorate, Warfighter Training Research Division.

EASI Consult (2008a. July 9). *AFOQT Composite Structure Validation: Subgroup Qualification Rates*. St. Louis, MO. EASI Consult LLC.

EASI Consult (2008b, September 12). *Validity of the AFOQT (Forms Q and S) for Performance in College and Air Force Academic Courses*. St. Louis, MO. EASI Consult LLC.

Elsmore, T. F. (1994). SYNWORK: A PC-based tool for assessment of performance in a simulated work environment. *Behavior Research Methods, Instrumentation, and Computers, 26*, 421-426.

Elsmore, T. F., Naitoh, P. & Linnville, S. (1994). *Performance Assessment in Sustained Operations* (Report No. 92-30). San Diego, CA. Naval Health Research Center.

Embretson, S. E. (1998). A cognitive design approach to generating valid tests: Application to abstract reasoning. *Psychological Methods, 3,* 380-396.

Endsley, M. R. & Garland, D. J. (2000). *Situation Awareness Analysis and Measurement*. Mahwah, NJ. Lawrence Erlbaum.

Endsley, M. R. (1990). Predictive utility of an objective measure of situation awareness. *Proceedings of the 34th Human Factors and Ergonomics Society Annual Meeting, 34*(1), 41-45. doi: 10.1177/154193129003400110

Endsley, M. R. (1995). Toward a theory of situational awareness in dynamic systems. *Human Factors, 37*(1), 32-64.

Endsley, M. R., & Bolstad, C. A. (1994). Individual differences in pilot situational awareness. *International Journal of Aviation Psychology, 4*(3), 241-264.

Facione, P. A., Facione N. C., & Giancarlo, C (2000). The disposition toward critical thinking: Its character, measurement, and relationship to critical thinking skills, *Journal of Informal Logic*, *20*, 61-84.

Farmer, W. L., Bearden, R. M., Fedak, G. E., Watson, S. E., Lightfoot, M. A., Alley, W. E., Schultz, S. R., & Heggestad, E. D. (2006). *Development of a Navy job-specific vocational interest model*. Millington, TN: Navy Personnel Research, Studies, and Technology Division Bureau of Naval Personnel (NPRST/PERS-1).

Fatolitis, P. G., Jentsch, F. G., Hancock, P. A., Kennedy, R. S., & Bowers, C. (2010). *Initial validation of novel performance-based measures: Mental rotation and psychomotor ability* (NAMRL 10-52). Pensacola, FL: Naval Aerospace Medical Research Laboratory.

Fischer, S. C., Spiker, V. A., Harris, D. H., McPeters, E. R., & Riedel, S. L. (2008). *Computerized training in critical thinking (CT) 2: A skill-based program for Army personnel* (ARI Research Report 1880). Arlington, VA: Army Research Institute for the Behavioral and Social Sciences.

Fishbein, M., & Ajzen, I. (1975). *Belief, attitude, intention, and behavior: An introduction to theory and research.* Reading, MA: Addison-Wesley.

Gould, R. B., & Damos, D. L. (2005, March). *Feasibility of developing a common US Army Helicopter Pilot Candidate Selection System: Analysis of US Air Force data.* Gurnee, IL: Damos Aviation Services.

Heffner, T. S, White, L., & Owens, K. S. (2010). *Tier one performance screen* (JO-04). Paper presented at 27th Army Science Conference,

Held, J. D. & Wolfe, J. H. (1997). Validities of unit-weighted composites of the ASVAB and the ECAT batter. *Military Psychology, 9*, 77-84.

Hoffman, M. (2009, January 24). UAV sensor operators may get own AFSC. *AirForceTimes.* Retrieved August 28, 2010, from http://www.airforcetimes.com/news/2009/01/airforce_sensor_operators_012409/

Hoffman, M. (2010, October 30). Academy wants cadets to consider RPA career. *AirForceTimes.* Retrieved March 30, 2011, from http://www.airforcetimes.com/news/2010/10/af-academy-wants-RPA-career-103010w/

Horn, J. L. & Noll, J. (1997). Human cognitive abilities: Gf-Gc theory. In D.P. Flanagan, J.L. Genshaft, & P.L. Harrison (Eds.), *Contemporary intellectual assessment: Theories, tests, and issues* (pp. 53–90). New York, NY: Guilford Press.

Horn, J. L. (1965). *Fluid and crystallized intelligence: A factor analytic study of the structure among primary mental abilities.* Unpublished doctoral dissertation, University of Illinois.

Houston, J. S., & Bruskiewicz, K. T. (2006). *Development and preliminary validation of a selection instrument for U.S. Army Flight Training (SIFT): Volume 1* (TR 523). Minneapolis, MN: Personnel Decisions Research Institutes.

Houston, J. S., Borman, W. C., Farmer, W. F., & Bearden, R. M. (2006). *Development of the Navy Computer Adaptive Personality Scales (NCAPS)* (NPRST-TR-06-02). Millington, TN: Navy Personnel Research, Studies, and Technology Division Bureau of Naval Personnel (NPRST/PERS-1). http://handle.dtic.mil/100.2/ADA456977

Kalita, S. W., & Duma, K. M. (2008a). *U.S. Air force unmanned aircraft systems performance analysis: Predator pilot multiple aircraft control front end analysis (FEA) report*. Wright-Patterson AFB, OH: SURVIAC.

Kalita, S. W., & Duma, K. M. (2008b). *U.S. Air force unmanned aircraft systems performance analysis: Predator sensor operator multiple aircraft control (MAC) front end analysis (FEA) report*. Wright-Patterson AFN, OH: SURVIAC.

Katz, L. C. (2006*). Finding the „Right Stuff‟:Development of any Army aviator selection instrument.* Paper presented at the 25th Army Science Conference. Ft. Rucker, AL: US Army Research Institute for the Behavioral and Social Sciences.

Kay, G., Dolgin, D., Wasel, B,, Langelier, M., & Hoffman, C. (1999). *Identification of the cognitive, psychomotor, and psychosocial skill demands of uninhabited combat aerial vehicle (UCAV) operators.* Patuxent River, MD: Naval Air Warfare Center Aircraft Division.

Kilcullen, R. N., Mael, F. A., Goodwin, G. F., & Zazanis, M. M. (1999). Predicting U.S. Army Special Forces field performance. *Human Performance in Extreme Environments, 4,* 53-63.

Kilcullen, R. N., Putka, D. J., McCloy, R. A., & Van Iddekinge, C. H. (2005). Development of the rational biodata inventory (RBI). In D.J. Knapp, C.E. Sager, & T.R. Tremble (Eds.), *Development of experimental Army enlisted personnel selection and classification tests and job performance criteria* (Technical Report 1168). Arlington, VA: U.S. Army Research Institute for the Behavioral and Social Sciences.

Kilcullen, R. N., White, L. A., Sanders, M., & Hazlett, G. (2003). *The Assessment of Right Conduct (ARC) administrator‟s manual.* (Research Note 2003-09). Alexandria, VA: U.S. Army Research Institute for the Behavioral and Social Sciences.

King, R. E., Manning, C. A., & Drechsler, G. K. (2007). *Operational use of the Air Traffic Selection and Training Battery* (DOT/FAA/AM-0714). Oklahoma City, OK: Civil Aerospace Medical Institute, Federal Aviation Administration.

Knapp, D. J. & Heffner, T. S. (2009). *Validating future force performance measures (Army Class): End of training longitudinal validation*. (FR-09-16). Alexandria, VA. Human Resources Research Organization.

~~Knapp, D. J. & Heffner, T. S. (2010). *Expanded enlistment eligibility metrics (EEEM):*~~

Recommendations on a non-cognitive screen for new soldier selection. (FR-09-27). Alexandria, VA. Human Resources Research Organization.

Knapp, D. J. & Tremble, T. R. (2007). *Concurrent validation of experimental Army enlisted Personnel selection and classification measures*. (Tech. Rept. 1205). Arlington, VA. U.S. Army Research Institute for the Behavioral and Social Sciences.

Kubisiak, C. & Katz, L. (2006). *U.S. Army Aviator job analysis* (ARI TR 1189). Alexandria, VA: U.S. Army Research Institute for the Behavioral and Social Sciences.

Lyle, A. (2010, June 9). *Air Force officials announce remotely piloted aircraft pilot training pipeline.* Retrieved August 28, 2010, from U.S. Air Force Web site: http://www.af.mil/news/story.asp?id=123208561.

Mangos, P. M., Arnold, R. D., Mead, A., Merket, D., Littrell, L., Credo, K., Young, R., Tolentino, A., & Kessler, S. (2005). *Analysis of work of Naval aviation training pipelines.* Pensacola, FL: Naval Aerospace Medical Institute.

Matthews, M. D., & Beal, S. A. (2002). *Assessing situational awareness in field training exercises* (ARI Research Report 1795). Alexandria, VA: U.S. Army Research Institute for the Behavioral and Social Sciences.

McClough, A. C., & Rogelberg, S. G. (2003). Selection in teams: An exploration of the Teamwork Knowledge, Skills, and Ability Test. *International Journal of Selection and Assessment, 11*, 56-66.

McCloy, R., Campbell, J., Oswald, F., Lewis, P., & Rivkin, D. (1999). *Generation and use of occupational ability profiles for exploring O*NET occupational units*. Raleigh, NC: National O*NET Center.

McHenry, J. J., Hough, L. M., Toquam, J. L., Hanson, M. A., & Ashworth, S. (1990). Project A validity results: The relationship between predictor and criterion domains. *Personnel Psychology, 43,* 335–354.

Metrica. (1997). *The Air Force Self Description Inventory (AFSDI): A summary of continuing research.* San Antonio, TX: Author.

Montijo, G. A., Kaiser, D., Spiker, V. A., & Nullmeyer, R. (2008). *Training interventions for reducing flight mishaps.* Paper No. 8042 presented at the Interservice/Industry Training, Simulation, and Education Conference (I/ITSEC), Orange County, CA.

Morath, R., Parish, C., & Lodato, M. (2008). *AFOQT Form S effectiveness analyses: Subtest level analyses and report*. Fairfax, VA: IFC International.

Nagy, J. E., Kalita, S. W., & Eaton, G. (2006a). *U.S. Air Force unmanned aircraft systems performance analysis: Predator pilot front end analysis (FEA) report*. Wright- Patterson AFB, OH: SURVIAC.

Nagy, J. E., Eaton, G., & Muse, K. (2006b). *U.S. Air Force unmanned aircraft systems*

performance analysis: Predator sensor operator front end analysis (FEA) report. Wright- Patterson AFB, OH: SURVIAC.

O'Brian, K., S. & O'Hare, D. (2007). Situational awareness ability and cognitive skills training in a complex real-world task. *Ergonomics, 50*(7), 1064-1091.

O'Hare, D. (1997). Cognitive ability determinants of elite pilot performance. *Human Factors, 39*, 540-552.

Olea, M. M., & Ree, M. J. (1994). Predicting pilot and navigator criteria: Not much more than g. *Journal of Applied Psychology, 79*, 845-851.

Ostoin, S. D. (2007). *An assessment of the Performance-based Measurement Battery (PBMB): The Navy"s Psychomotor Supplement to the Aviation Selection Test Battery (ASTB)* (unpublished thesis). Monterey, CA: Naval Postgraduate School.

Oswald, F. L., Hambrick, D. Z., Jones, L. A. & Ghumman, S. S. (2007). *SYRUS: Understanding and predicting multitasking performance* (NPRST-TN-07-5). Millington, TN: Navy Personnel Research, Studies and Technology.

Paullin, C., Katz, L., Bruskiewicz, K.T., Houston, J.S., & Damos, D. (2006). *Review of aviator selection* (ARI-TR-1183). Alexandria, VA: Army Research Institute for the Behavioral and Social Sciences.

Pelchat, D. (1997, April). *The Canadian Automated Pilot Selection System (CAPSS): Validation and Cross-validation Results.* Paper presented at the Ninth International Symposium on Aviation Psychology. Columbus, OH: The Ohio State University.

Pestana, M. (2007). *NASA MQ-9 Ikhana human factors: Pilot perspective* (briefing slides). Edwards AFB: Dryden Flight Research Center. Retrieved January 16, 2010 from http://ntrs.nasa.gov/archive/nasa/casi.ntrs.nasa.gov/20100039990_2010042007.pdf

Peterson, N. G., Mumford, M. D., Borman, W. C., Jeanneret, P. R., & Fleishman, E. A. (1999). *An occupational information system for the 21st Century: The development of O*NET.* Washington, DC: American Psychological Association.

Phillips, H. L. (2003). *Pioneer UAV selection battery.* Paper presented at the 49th meeting of the U.S. Department of Defense Human Factors Engineering Technical Advisory Group, Augusta, GA.

Phillips, H.L., Arnold, R.D., & Fatolitis, P. (2003, November). Validation of an unmanned aerial vehicle operator selection system. In *Proceedings of the 45th Annual Conference of the International Military Testing Association* (pp. 129-139), Pensacola, FL.

Pulakos, E. D., Arad, S., Donovan, M. A., & Plamondon, K. E. (2000). Adaptability in the workplace: Development of a taxonomy of adaptive performance. *Journal of Applied Psychology, 85* (4), 612-624.

Pulakos, E.D., Schmitt, N., Dorsey, D.W., Arad, S., Hedge, J.W., & Borman, W.C. (2002).

Predicting adaptive performance: Further tests of a model of adaptability. *Human Performance, 15* (4), 299-323.

Putka, D. J. (Ed.) (2009). *Initial development and validation of assessments for predicting disenrollment of four-year scholarship recipients from the Reserve Officer Training Corps* (SR 2009-06). Arlington, VA: Army Research Institute for the Behavioral and Social Sciences.

Putka, D.J., & McCloy, R.A. (2004). Effects of recruit characteristics on first-term attrition. In D.J. Knapp, E.D. Heggestad, & M.C. Young (Eds.), *Understanding and improving the Assessment of Individual Motivation (AIM) in the Army"s GED Plus Program* (ARI Study Note 2004-03). Alexandria, VA: US Army Research Institute for the Behavioral and Social Sciences.

Putka, D. J., Kilcullen, R. N., Tremble, T. R., Wasko, L. E., & Shaw, M. (2009). *An investigation into the validity of the cadet background experiences form* (FR-09-53). Alexandria, VA. Human Resources Research Organization.

Ramos, R. A., Heil, M. C., Manning, C. A. (2001a). *Documentation of validity for the AT-SAT computerized test battery, Volume I.* (DOT/FAA/AM-01/05). Washington, DC: FAA Office of Aviation Medicine.

Ramos, R.A., Heil, M.C., Manning, C.A. (2001b). *Documentation of validity for the AT-SAT computerized test battery, Volume II.* (DOT/FAA/AM-01/06). Washington, DC: FAA Office of Aviation Medicine.

Raven, J., Raven, J. C., & Court, J. H. (2003). *Raven manual: Section I* (General Overview). Oxford: Oxford Psychologists Press Limited.

Raven, J. C. (1938). *Progressive matrices: A perceptual test of intelligence*. London: H.K. Lewis.

Ree, M. J. (2003a). *Test of Basic Aviation Skills (TBAS): Incremental validity beyond AFOQT Pilot composite for predicting pilot criteria* (unpublished technical report). San Antonio, TX: Operational Technologies Corporation.

Ree, M. J. (2003b). *Test of Basic Aviation Skills (TBAS): Scoring the tests and compliance of the tests with standards of the American Psychological Association* (unpublished technical report). San Antonio, TX: Operational Technologies Corporation.

Ree, M. J. (2004). *Reliability of the Test of Basic Aviation Skills (TBAS)* (unpublished technical report). San Antonio, TX: Operational Technologies Corporation.

Roscoe, S. N., Carl, L. & LaRoche, J. (2001). *Predicting Human Performance*. Saint Laurent QC, Helio Press, Inc.

Russell, T. L., Sinclair, A., Erdheim, J., Ingerick, M., Owens, K., Peterson, N., & Pearlman, K. (2008). *Evaluating the O*NET Occupational Analysis System for Army competency development* (ARI Research Note 2008-07). Arlington, VA: U.S. Army Research Institute for the Behavioral and Social Sciences. Retrieved from

http://handle.dtic.mil/100.2/ADA493578

Russell, T. L., & Peterson, N. G. (2001). The Experimental Battery: Basic attribute scores for predicting performance in a population of jobs. In J.P. Campbell and D.J. Knapp (Eds.), *Exploring the limits in personnel selection and classification*. Mahwah, NJ: Lawrence Erlbaum Associates.

Russell, T. L., & Tremble, T. R. (Eds.). (2009). *Development and validation of measures for selecting Soldiers for Officer Candidate School* (FR-09-38). Alexandria, VA: Human Resources Research Organization.

Russell, T. L., Peterson, N. G., Rosse, R. L., Hatten, J. T., McHenry, J. J., & Houston, J. S. (2001). The measurement of cognitive, perceptual, and psychomotor abilities. In J.P. Campbell & D.J. Knapp (Eds.), *Exploring the limits in personnel selection and classification* (pp. 71–-109). Hillsdale, NJ: Erlbaum Associates, Inc.

Sager, C. E., Peterson, N. G., Oppler, S. H., Rosse, R. L., & Walter, C. B. (1997). An examination of five indexes of test battery performance: Analysis of the ECAT battery. *Military Psychology, 9,* 97–118.

Schanz, M. V. (2010, February). The indispensable weapon. *Air Force Magazine,* 32-36. Retreived August 28, 2010, from http://www.airforce-magazine.com/MagazineArchive/Pages/2010/February%202010/0210weapon.aspx

Schmidt, J.K. (2004). *ASTB Update*. Paper presented at the 52nd meeting of the U.S. Department of Defense Human Factors Engineering Technical Advisory Group Meeting, Alexandria, VA.

Shore, C. W., & Gould, R. B. (2003). *Developing Pilot and Navigator/Technical Composites for the Air Force Officer Qualifying Test (AFOQT) Form S.* Operational Technologies Corporation. San Antonio, TX.

Stark, S., & Drasgow, F., & Chernyshenko, O. S. (2008). *Update on the Tailored Adaptive Personality Assessment System (TAPAS): The next generation of personality assessment systems to support personnel selection and classification decisions*. Paper presented at the 50th annual conference of the International Military Testing Association. Amsterdam, NL.

Stark, S., Chernyshenko, O. S., & Drasgow, F. (2010). Tailored Adaptive Personality Assessment System (TAPAS-95s). In D. J. Knapp & T. S. Heffner (Eds.), *Expanded Enlistment Eligibility Metrics (EEEM : Recommendations on a non-cognitive screen for new Soldier selection* (Technical Report 1267). Arlington, VA: U.S. Army Research Institute for the Behavioral and Social Sciences.

Sternberg, R. J. (1986). *Critical thinking: Its nature, measurement, and improvement.* National Institute of Education, Washington DC, 1986.

Stevens, M. J., & Campion, M. A. (1999). Staffing work teams: Development and validation of a selection test for teamwork settings. *Journal of Management, 25*, 207-228.

Thornton, G. C. III, & Rupp, D. E. (2004). Simulations and assessment centers. In Thomas, J.C. (Ed.), *Comprehensive handbook of psychological assessment: Vol 4.* Hoboken, NJ: John Wiley & Sons.

Tirpak, J. A. (2010, July). Putting the pilot in the RPAs. *Air Force Magazine, 93* (7). Retrieved August 28, 2010, from http://www.airforce-magazine.com/MagazineArchive/Pages/2010/July%202010/0710drones.aspx

Tsacoumis, S. (2007). Assessment centers. In D.L. Whetzel & G.R. Wheaton (Eds.) *Applied measurement: Industrial psychology in human resources management*. Mahwah, NJ: Lawrence Erlbaum Associates, Publishers.

Tsacoumis, S., Anderson, L. E., & King, R. E. (2006). *Development of an equivalent alternate form of the Air Traffic Selection and Training battery (AT-SAT)*, DTFAAC-05-F-00206. Unpublished manuscript, Human Resources Research Organization.

Tvaryanas, A. P. (2006). Human systems integration in remotely piloted aircraft operations. *Aviation, Space, and Environmental Medicine, 77*(12), 1278-1282.

Tvaryanas, A. P. (2006). *Unmanned aircraft system (UAS) skill sets.* Briefing slides. Randolph AFB: U.S. Air Force Personnel Center. U.S. Air Force. (4 August

2008). *UAS Operator Way Ahead.* Briefing Slides.

U.S. Department of Labor (1991). *Dictionary of occupational titles*. (Rev. 4th ed.). Washington, DC: U.S. Government Printing Office.

U.S. General Accountability Office. (2010). *Unmanned aircraft systems: Comprehensive planning and a results oriented training strategy are needed to support growing inventories* (GAO-10-331). Washington, DC: Author.

Van Iddekinge, C., Putka, D. J., & Sager, C. E. (2005). Person-environment fit measures. In D. J. Knapp, C. E. Sager, T. R. Tremble (Eds.), *Development of experimental Army enlisted personnel selection and classification tests and job performance criteria* (TR 1168) (pp. 195-255). Arlington, VA: U.S. Army Research Institute for the Behavioral and Social Sciences.

Waters, S. D., Russell, T. L., Sellman, W. S. (2007). *Review of nonverbal reasoning tests* (FR-07-036). Alexandria, VA: Human Resources Research Organization.

Watson, G. & Glaser, E. M. (2009). *Watson-Glaser II Critical Thinking Appraisal, technical manual and user"sguide*. San Antonio, TX: Pearson.

Watson, G., & Glaser, E. M. (1994). *Watson-Glaser Critical Thinking Appraisal, Form S manual*. San Antonio, TX: The Psychological Corporation.

Weekley, J. A. & Ployhart, R. E. (Eds.) (2006). *Situational judgment tests.* Mahwah, NJ: Lawrence Erlbaum Associates.

Weissmuller, J. J., & Schwartz, K. L. (2008). *Person-Job-Match (PJM) – Beyond the "more is better" paradigm.* Paper presented at the annual conference of the International Military Testing Association, Amsterdam, The Netherlands. Retrieved from http://www.imta.info/PastConferences/Presentations.aspx.

Weissmuller, J. ., Schwartz, K. L., Kenney, S. D., Shore, C. W., & Gould, R. B. (2004). *Recent developments in USAF Officer testing and selection*. Paper presented at the 46th Annual Conference of the International Military Testing Association, Brussels, Belgium.

Welsh, J. R., Kucinakas, S. K., & Curran, L. T. (1990). Armed Services Vocational Battery (ASVAB): Integrative Review of Validity Studies (AFHRL-TR-90-22). San Antonio, TX: Operational Technologies Corporation.

White, L. A., & Young, M. C. (1998, August). *Development and validation of the Assessment of Individual Motivation (AIM).* Paper presented at the Annual Meeting of the American Psychological Association, San Francisco, CA.

White, L. A., Young, M. C., Heggestad, E. D., Stark, S., Drasgow, F., & Piskator, G. (2004, December). *Development of a non-high school diploma graduate pre-enlistment screening model to enhance the future force.* Paper presented at the 24th Army Science Conference, Orlando, FL. (www.asc2004.com/manuscripts)

White, L. A., Young, M. C., Heggestad, E. D., Stark, S., Drasgow, F., & Piskator, G. (2005, March). *Army Tier Two Attrition Screen (TTAS) Update* [Briefing Slides]. Presented to The Manpower Accession Policy Working Group, Monterey, CA.

White, L. A., Young, M. C., & Rumsey, M. G. (2001). ABLE implementation issues and related research. In J.P. Campbell and D.J. Knapp (Eds.), *Exploring the limits in personnel selection and classification*. Mahwah, NJ: Lawrence Erlbaum Associates.

Wise, L. L., Tsacoumis, S. T., Waugh, G. W., & Putka, D. J. (2003). *Resetting AT-SAT test weights/passing level to reduce adverse impact.* Paper presented at the Annual Convention of the American Psychological Association, Toronto, Canada.

Wise, L., Welsh, J., Grafton, F., Foley, P., Earles, J., Sawin, L., & Divgi, D. R. (1992, December). *Sensitivity and fairness of the Armed Services Vocational Aptitude Battery (ASVAB) Technical Composites* (DMDC Technical Report 92-002). Washington, DC: Defense Manpower Data Center, Personnel Testing Division.

Wise, L. L., Tsacoumis, S. T., Waugh, G. W., Putka, D. J., & Hom, I. (2001). *Revisions of the AT- SAT* (DTR-01-58). Alexandria, VA: Human Resources Research Organization.

Wolfe, J. H. (1997a). Incremental validity of ECAT Battery factors. *Military Psychology, 9*(1), 49-76.

Wolfe, J. H. (1997b). Stepwise selection of ECATs for maximum mean validity. *Military Psychology, 9*, 85-95.

Wolfe, J. H., Alderton, D. L., Larson, G. E., & Held, J. D. (1995, December). *Incremental validity of Enhanced Computer Administered Testing (ECAT)* (TN-96-6). San Diego: Navy Personnel Research and Development Center. (NTIS No. AD-A307 708)

Woycheshin, D. E. (1999). *CAPSS: The Canadian Automated Pilot Selection System*. Paper presented at the Workshop of the RTO Human Factors and Medicine Panel (HFM), Monterey, CA, USA.

Young, M. C., Heggestad, E. D., Rumsey, M. G., & White, L. A. (2000). *Army pre-implementation research findings on the Assessment of Individual Motivation (AIM).* Paper presented at the Annual Meeting of the American Psychological Association, Washington, DC.

Appendix A. Preliminary List of SAOCs

Table A.1. Skills relevant to RPA Pilot and SO occupations[6].

Skill Type		Skill	Definition
BASIC SKILLS - Developed capacities that facilitate learning or the more rapid acquisition of knowledge	*Content Skills - Basic skills needed to work with and acquire more specific skills in a variety of domains.*	Active Listening	Giving full attention to what other people are saying, taking time to understand the points being made, asking questions as appropriate, and not interrupting at inappropriate times
	Process Skills - Procedures that contribute to the more rapid acquisition of knowledge and skill across a variety of domains	Critical Thinking	Using logic and reasoning to identify the strengths and weaknesses of alternative solutions, conclusions or approaches to problems.
CROSS FUNCTIONAL SKILLS - Developed capacities that facilitate performance of activities that occur across jobs	*Social Skills - Developed capacities used to work with people to achieve goals*	Social Perceptiveness	Being aware of others' reactions and understanding why they react as they do.
		Coordination	Adjusting actions in relation to others' actions
		Persuasion	Persuading others to change their minds or behavior
		Instructing	Teaching others how to do something

[6] Skill categories, titles, and definitions are from the O*NET taxonomy. (See http://www.onetcenter.org/content.html)

Skill Type		Skill	Definition
	Complex Problem Solving - Identifying complex problems and reviewing related information to develop and evaluate options and implement solutions	Complex Problem Solving	Identifying complex problems and reviewing related information to develop and evaluate options and implement solutions
	Systems Skills - Developed capacities used to understand, monitor, and improve socio-technical systems	Systems Analysis	Determining how a system should work and how changes in conditions, operations, and the environment will affect outcomes
		Judg. and Dec. Making	Considering the relative costs and benefits of potential actions to choose the most appropriate one
	Resource Management Skills - Developed capacities used to allocate resources efficiently	Time Management	Managing one's own time and the time of others

Table A.2. Abilities relevant to RPA Pilot and SO occupations. [7]

Ability Category	Ability	Definition
Verbal Abilities - *Abilities that influence the acquisition and application of verbal information in problem solving*	Oral Comprehension	The ability to listen to and understand information and ideas presented through spoken words and sentences.
	Written Comprehension	The ability to read and understand information and ideas presented in writing.
	Oral Expression	The ability to communicate information and ideas in speaking so others will understand.
	Problem Sensitivity	The ability to tell when something is wrong or is likely to go wrong. It does not involve solving the problem, only recognizing there is a problem
	Deductive Reasoning	The ability to apply general rules to specific problems to produce answers that make sense.
	Inductive Reasoning	The ability to combine pieces of information to form general rules or conclusions (includes finding a relationship among seemingly unrelated events).
	Information Ordering	The ability to arrange things or actions in a certain order or pattern according to a specific rule or set of rules (e.g., patterns of numbers, letters, words, pictures, mathematical operations).
Quantitative Abilities- *Abilities that influence the solution of problems involving mathematical relationships*	Mathematical Reasoning	The ability to choose the right mathematical methods or formulas to solve a problem.
	Number Facility	The ability to add, subtract, multiply, or divide quickly and correctly.

[7] With the exception of "Situational Awareness," ability categories, titles, and definitions are taken from the O*NET taxonomy. (See http://www.onetcenter.org/content.html)

Ability Category	Ability	Definition
Memory- *Abilities related to the recall of available information*	Working Memory**	The ability to temporarily hold information in memory while processing other information.
	Memorization	The ability to remember information such as words, numbers, pictures, and procedures.
	Flexibility of Closure	The ability to identify or detect a known pattern (a figure, object, word, or sound) that is hidden in other distracting material.
	Perceptual Speed	The ability to quickly and accurately compare similarities and differences among sets of letters, numbers, objects, pictures, or patterns. The things to be compared may be presented at the same time or one after the other.
Spatial Abilities *- Abilities related to the manipulation and organization of spatial information*	Spatial Orientation	The ability to know your location in relation to the environment or to know where other objects are in relation to you.
	Visualization	The ability to imagine how something will look after it is moved around or when its parts are moved or rearranged.
Attentiveness *- Abilities related to application of attention*	Selective Attention	The ability to concentrate on a task over a period of time without being distracted.
	Time Sharing	The ability to shift back and forth between two or more activities or sources of information (such as speech, sounds, touch, or other sources).
Fine Manipulative Abilities *- Abilities related to the manipulation of objects*	Arm-Hand Steadiness	The ability to keep your hand and arm steady while moving your arm or while holding your arm and hand in one position.
	Manual Dexterity	The ability to quickly move your hand, your hand together with your arm, or your two hands to grasp, manipulate, or assemble objects.
	Finger Dexterity	The ability to quickly move your hand, your hand together with your arm, or your two hands to grasp, manipulate, or assemble objects.

Ability Category	Ability	Definition
Control Movement Abilities *- Abilities related to the control and manipulation of objects in time and space*	Control Precision	The ability to quickly and repeatedly adjust the controls of a machine or a vehicle to exact positions.
	Multi-limb Coordination	The ability to coordinate two or more limbs (for example, two arms, two legs, or one leg and one arm) while sitting, standing, or lying down. It does not involve performing the activities while the whole body is in motion.
	Response Orientation	The ability to choose quickly between two or more movements in response to two or more different signals (lights, sounds, pictures). It includes the speed with which the correct response is started with the hand, foot, or other body part.
	Rate Control	The ability to time your movements or the movement of a piece of equipment in anticipation of changes in the speed and/or direction of a moving object or scene.
Reaction Time and Speed Abilities *-Abilities related to speed of manipulation of objects*	Reaction Time	The ability to quickly respond (with the hand, finger, or foot) to signal (sound, light, picture) when it appears.
Visual Abilities *- Abilities related to visual sensory input (Near, Far, Night, & Peripheral Vision, Visual Color Discrimination, Depth Perception and Glare Sensitivity)*		
Auditory and Speech Abilities *- Abilities related to auditory and oral input*		
Physical Strength *- Abilities related to the capacity to exert force (Static, Explosive, Dynamic, & Trunk strength)*		
Endurance *- The ability to exert oneself physically over long periods without getting out of breath (Stamina, Extent Flexibility, Dynamic Flexibility, & Gross Body Coordination and/or Equilibrium)*		

Ability Category	Ability	Definition
Situational Awareness (Non-O*NET)		The ability to maintain the wide breadth of awareness and a fully cognizant state. Situational Awareness represents the combined effectiveness of the perceptual system, short term memory, reasoning ability, spatial processing, psychomotor abilities and information processing (i.e., the effective capacity of the whole cognitive system).

Table A.3. Work Styles relevant to RPA Pilot and SO occupations.[8]

Category	Work Style	Definition
Achievement Orientation - Setting personal goals, trying to succeed at those goals, and striving to be competent in own work	Achievement/Effort	Establishing and maintaining personally challenging achievement goals and exerting effort toward mastering tasks.
	Persistence	Persisting in the face of obstacles.
	Initiative	Willingness to take on responsibilities and challenges.
Social Influence - Having an impact on others in the organization, and displaying energy and leadership	Leadership	Willingness to lead, take charge, and offer opinions and direction.
Interpersonal Orientation - Being pleasant, cooperative, sensitive to others, easy to get along with, and having a preference for associating with other organization members	Cooperation	Being pleasant with others on the job and displaying a good-natured, cooperative attitude.
Adjustment - Maturity, poise, flexibility, and restraint to cope with pressure, stress, criticism, setbacks, personal and work-related problems, etc.	Self Control	Maintaining composure, keeping emotions in check, controlling anger, and avoiding aggressive behavior, even in very difficult situations.
	Stress Tolerance	Accepting criticism and dealing calmly and effectively with high stress situations.
	Adaptability/Flexibility	Being open to change (positive or negative) and to considerable variety in the workplace.

[8] Work Style categories, titles, and definitions are taken from the O*NET taxonomy. (See http://www.onetcenter.org/content.html)

Category	Work Style	Definition
Conscientiousness - Dependability, commitment to doing the job correctly and carefully, and being trustworthy, accountable, and attentive to details	Dependability	Requires being reliable, responsible, and dependable, and fulfilling obligations.
	Integrity	Being honest and ethical.
	Independence	Developing one's own ways of doing things, guiding oneself with little or no supervision, and depending on oneself to get things done.
Practical Intelligence - Generating useful ideas and thinking things through logically	Analytical Thinking	Analyzing information and using logic to address work-related issues and problems.

Appendix B
Information about Existing Measures that Could be Used for RPA Operator Selection

Appendix B_Potential
Predictors for RPA O

Appendix C
Original List of Work Context Factors

Source	#	Work Context Statement
Army ONET	1	Required to work indoors or in an environmentally controlled environment.
Army ONET	2	Required to work in enclosed or cramped spaces.
Army ONET	3	Exposed to sounds and noise levels that are distracting and uncomfortable.
Army ONET	4	Exposed to extreme temperatures (hot or cold).
Army ONET	5	Required to work at night or under inadequate lighting conditions.
Army ONET	6	Exposed to significant levels of physical or mental discomfort, stress, or strain.
Army ONET	7	Required to work with limited, inadequate, or defective equipment, supplies, or materials.
Army ONET	8	Required to work long hours or take on additional duties due to limited or inadequate personnel.
Army ONET	9	Required to perform their duties with limited or inadequate information or instructions.
Army ONET	10	Required to work through frequent or unscheduled interruptions that make it hard to complete their work on time.
Army ONET	11	Required to respond to frequent crises or emergencies.
Army ONET	12	Afforded the freedom to determine the timing and scheduling of their work.
Army ONET	13	Afforded the freedom to determine which methods and procedures are used to complete their work.
Army ONET	14	Required to work at a pace or speed determined by equipment or technology.
Army ONET	15	Required to make decisions that affect, or could affect, others.
Army ONET	16	Required to perform duties of long or extended duration.
Army ONET	17	Required to work long or extended hours with little to no sleep.
Army ONET	18	Afforded limited rest or recovery time between stressful or demanding tasks.
Army ONET	19	Required to plan or perform under significant time pressure.
Army ONET	20	Required to be very precise and highly accurate when completing their tasks.
Army ONET	21	Required to perform under circumstances of conflicting or ambiguous directions, orders, or priorities.

Source	#	Work Context Statement
Army ONET	22	Required to work under minimal or limited supervision.
Army ONET	23	Required to perform duties for which they received minimal or limited training.
Army ONET	24	Required to perform non-job specific duties or to complete tasks outside of their job.
Army ONET	25	Required to depend heavily on technology or equipment to complete their tasks.
Army ONET	26	Required to perform continuous, repetitive physical or mental tasks.
Army ONET	27	Required to interact or deal with non-hostile host country nationals.
Army ONET	28	Required to interact or deal with hostile but non-violent host country nationals or groups.
Army ONET	29	Required to deal with violent or physically aggressive host country nationals or groups.
Army ONET	30	Required to interact or work with non-Air Force personnel.
Army ONET	31	Required to perform work that is highly visible to others and for which others can observe what they are doing.
Army ONET	32	Required to interact or work with challenging and difficult coworkers.
Army ONET	33	Required to work closely with or depend heavily on others to complete their own duties.
Army ONET	34	Required to perform their work largely on their own, with little assistance from others.
Army ONET	35	Required to interact and work with others at a distance (e.g., through e-mail or other forms of electronic communication).
Army ONET	36	Required to work as a member of a team consisting of individuals outside of the Soldier's unit or the Air Force.
Army ONET	37	Required to coordinate or lead others for whom the Soldier has no direct authority.
Army ONET	38	Required to persuade or influence others for whom the Soldier has no direct authority.
Army ONET	39	Required to be responsible for the health and safety of non-Air Force personnel.

Source	#	Work Context Statement
new	40	Required to maintain high levels of attention, even when there is little activity.
new	41	May be required to take actions against persons with whom they have formed a psychological attachment with.
new	42	Required to sit for prolonged periods of time.
new	43	Required to work rotating duty shifts.
new	44	May experience motion sickness.
new	45	Exposed to personal danger or individual risks, man-made or natural.
new	46	May be required to deploy for extended periods of time
new	47	May be required to shift roles between soldier and civilian immediately and on constant basis (i.e., daily).

Appendix D.
Field Test Version of the P-E Fit Measure

Note. This measure has been removed prior to publication and distribution.